DISSERTATION ON

"EVALUATION OF EUSTACHIAN TUBE FUNCTION IN CHRONIC SUPPURATIVE OTITIS MEDIA (TUBOTYMPANIC TYPE) WITH REFERENCE TO SURGICAL OUTCOME"

Dissertation submitted in partial fulfillment

of the regulations for the award of the degree of

M.S.DEGREE BRANCH-IV

OTORHINOLARYNGOLOGY

of

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

UPGRADED INSTITUTE OF OTORHINOLARYNGOLOGY,

MADRAS MEDICAL COLLEGE, CHENNAI.

APRIL 2016

DISSERTATION ON

"EVALUATION OF EUSTACHIAN TUBE FUNCTION IN CHRONIC SUPPURATIVE OTITIS MEDIA (TUBOTYMPANIC TYPE) WITH REFERENCE TO SURGICAL OUTCOME"

Dissertation submitted in partial fulfillment

of the regulations for the award of the degree of

M.S.DEGREE BRANCH-IV

OTORHINOLARYNGOLOGY

of

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

UPGRADED INSTITUTE OF OTORHINOLARYNGOLOGY,

MADRAS MEDICAL COLLEGE, CHENNAI.

APRIL 2016

CERTIFICATE

This is to certify that this dissertation **"EVALUATION OF EUSTACHIAN TUBE FUNCTION IN CHRONIC SUPPURATIVE OTITIS MEDIA (TUBOTYMPANIC TYPE) WITH REFERENCE TO SURGICAL OUTCOME"** submitted by **Dr.M.YOGANANDH,** appearing forM.S ENT Branch IV Degree examination in April 2016 is a bonafide record of work done by him under our guidance and supervision in partial fulfillment of the regulations of the TamilnaduDr.M.G.R Medical University, Chennai. I forward this to the TamilnaduDr.M.G.R Medical University, Chennai, Tamilnadu, India.

GUIDE

PROF DR.R.MUTHUKUMAR MS,DLO,DNB
Upgraded Institute Of Otorhinolaryngology
Madras Medical College
Rajiv Gandhi Govt, General Hospital
Chennai -600003

DIRECTOR AND PROFESSOR
Upgraded Institute Of Otorhinolaryngology
Madras Medical College
Rajiv Gandhi Govt, General Hospital
Chennai -600003

DEAN
Madras Medical College
Rajiv Gandhi Govt, General Hospital
Chennai -600003

DECLARATION

I solemnly declare that the dissertation entitled "**EVALUATION OF EUSTACHIAN TUBE FUNCTION IN CHRONIC SUPPURATIVE OTITIS MEDIA (TUBOTYMPANIC TYPE) WITH REFERENCE TO SURGICAL OUTCOME"** is done by me at Madras Medical College, Chennai-3 during November 2014 to December 2015 under the guidance and supervision of **ProfDR. R. MUTHUKUMAR M.S, DLO.,** to be submitted to The Tamil Nadu Dr.M.G.R Medial University towards the partial fulfillment of requirements for the award of M.S DEGREE in **OTORHINOLARYNGOLOGY**BRANCH-IV

DR.M.YOGANANDH

Post Graduate,

M.S ENT,

MMC & RGGGH,

Chennai - 600003

Place: Chennai

Date:

ACKNOWLEDGEMENT

I sincerely thank my guide **ProfDr. R. Muthukumar**, Upgradedinstitute of otorhinolaryngologywhose passion for teaching and interest in patient care with active academics has been a great source of inspiration to all the post graduates including me.

I thank my Director, Upgraded institute of otorhinolaryngology, my Chief coordinator **ProfDr. R. Muthukumar**who was instrumental in initiating new ideas and continues to support our endeavors.

I thank my professors **Dr.G.Sankaranarayanan** and **Dr.M.K.Rajasekar** and my Assistant Professors who were kind enough to support and help me in my project.

I would like to thank **Mrs. Jeya**, The Principal, Institute of Speech and Hearing and the Audiologists for their extended support and help in this project.

I would like to thank my Seniors,Colleagues, Juniors who were of great help throughout the project.

I thank My Patients without whose will this would not have been a successful effort. I also thank My Family and the Almighty for giving me the opportunity and strength to complete this project.

CONTENTS

ABBREVATIONS

ET	**-**	**Eustachian tube**
ETF	**-**	**Eustachian tube function**
CSOM	**-**	**Chronic suppurative otitis media**
TM	**-**	**Tympanic membrane**
PTA	**-**	**Puretone average**

INTRODUCTION

Normal Middle Ear functioning relies on Eustachian tube patency and its proper functioning. Any dysfunction of the Eustachian tube will lead to negative pressure build in the tympanum, which results in retraction, effusion and such complications.

Eustachian tube has three functions with respect to middle ear (i) Protection from Nasopharyngeal sound pressure and secretions (ii) Drainage into the Nasopharynx of middle ear secretion

(iii)Ventilation to equilibrate the air pressurein the middle ear with atmospheric pressure. Besides mechanical factors like gravity and air pressure gradient clearance of secretion from middle ear is influenced by (i) themucociliary transport mechanism of Eustachian tube (ii) active tubal opening (iii) surface tension factors.

Tubotympanic (mucosal) disease of ear – Chronic Suppurative Otitis Media is mainly due to infection from the oropharynx and nasopahrynx and sources like GERD travels via Eustachian tube into the middle ear.

Of the various factors that dictate the successful outcome of middle ear pathologies, Eustachian tube is the most important**.**Impedance audiometry is an essential tool to assess Eustachian tube function in non-intact Tympanic

membrane. Dye instillation test demonstrates the efficiency of mucociliary transport mechanism of Eustachian tube.

This study is undertaken to assess the Eustachian tube function in patients with Chronic Suppurative Otitis Media (Mucosal) with reference to its treatment outcome.

AIMS AND OBJECTIVES OF THE STUDY

1) To assess the Eustachian tube patency in chronic suppurative otitis media (Tubotympanic type)
2) To assess the mucociliary mechanism in Eustachian tube
3) To evaluate the treatment outcome of CSOM (tubotympanic type) in relation to Eustachian tube dysfunction.

REVIEW OF LITERATURE

Politzer more than 100 years ago suggested that abnormal function of the eustachian tube is the most important factor in the pathogenesis of middle ear disease.

Sade suggested that the retraction of the pats tensa serves as a buffering agent of middle ear negative pressures.

Bayramoglu et al stressed on the small mastoid cellular system allowing for less efficient gas exchange between the middle ear cleft and micro circulation of the mucosa.

Klein jo and bluestone elaborated on the unphysiological pressures that can develop in the nasopharynx and adversely affect the middle ear and eustachian tube when the nose and nasopharynx have inflammation or obstruction.

Bluestone et al have elucidated on the inflammative swelling of the eustachian tube mucosa in allergic individuals and subsequent eustachian tube dysfunction development.

Shure et al stated the use of visually inspecting the tympanic membrane as one of the simplest and oldest ways to assess how the

eustachian tube functions and provides a presumptive evidence of eustachian tube dysfunction.

Jerger has elaborated in the use of an immitance instrument to obtain a tympanogram as an excellent way of determining the middle ear system and in assessing eustachian tube function.

Elner et al reported that 86% of the otologically normal adults could perform the Valsalva maneuver while 79% perform the Toynbee.

Holmquist studied eustachian tube function in adults before and after tympanoplasty and reported that the operation has high rate of success in good eustachian tube function.

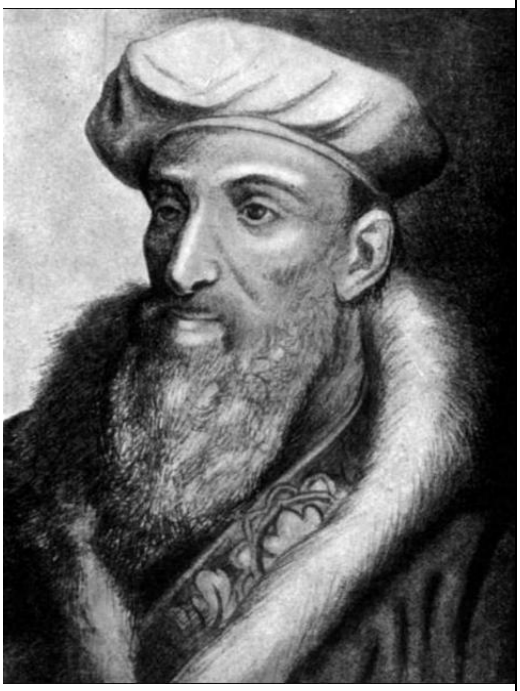
Palva and karja studied the eustachian tube patency in chronic ears and found no differences between the ears that failed tympanoplasty and those that succeeded.

Radiographic technique has been used by Welin, Aschen, Compere, Parisier and Kliani, Bluestone, Ferber and Holmquist. In this technique flow of contrast material from the middle ear to Nasopharynx (if tympanic membrane is not intact) is assessed. Rogersinstille fluorescein into the middle ear and assessed clearance

by examining Nasopharynx with Ultraviolet light. Bauer et al, used methylene blue for this purpose.Elbrod and Larsen used Saccharin for this test.

HISTORICAL PERSPECTIVE

Many historical figures have made invaluable contributions to our understanding of the eustachian tube.The most notable were Eustachius, Valsalva, Toynbee, Politzer, Rich, Perlman and Ingelstedt.

BARTHOLOMEUS EUSTACHIUS **(1510 – 1574)**	**VALSALVA** **(1666 – 1723)**
	

Bartholomeus Eustachius: In 1562 Eustachius published a detailed anatomy and physiology of Eustachian Tube.He also described the complex structure of cochlea.

JOSEPH TOYNBEE (1815 – 1866)	ADAM POLITZER (1835 – 1920)
	

Valsalva: He described the cartilaginous and osseous parts of the ET.He also described the valsalva maneuver.

Toynbee: He described the use of peritubal muscles in ET function by extensive investigations. He described the Toynbee's test.

Politzer: He made important contributions in connecting the role of ET in middle ear pathology. He described Politzerization.Politzer was first to describe Otosclerosis as a primary bone disease.

ANATOMY OF MIDDLE EAR CLEFT

DEVELOPMENT

The Eustachian tube develops from persistence of first pharyngeal pouch in the embryo. The endodermal lining of the first pharyngeal pouch extends laterally and contacts with the ectoderm of the firstgill furrow on either side of the gill plate. The distal pouch becomes elongated and forms the tubotympanicrecess. The middle ear cavity develops from tubotympanic recess. The proximal portion of the recess becomes narrowed to form the Eustachain tube

ANATOMY OF NASOPHARNYX

Nasopharynx (post nasal space) is the upper part of pharynx situated behind the nose and above the lower border of soft palate and Passavant's muscle.

It communicates

(i) Anteriorly – with posterior nasal apertures

(ii) Inferiorly – with oropharynx at pharyngeal isthmus

Lateral wall presents from anterior to posteriorly

(i) Pharyngeal opening of Eustachian tube

(ii) Tubal elevation bounds the tubal opening

(iii) Salpingopharyngeal fold with salpingopharynges muscle

(iv) Levatorpalati Muscle

(v) Fossa of Rosenmuller / Lateral recess / Pharyngeal Recess

Roof and posterior walls form a slope opposite the body of Sphenoid, basiocciput and anterior arch of atlas. It presents

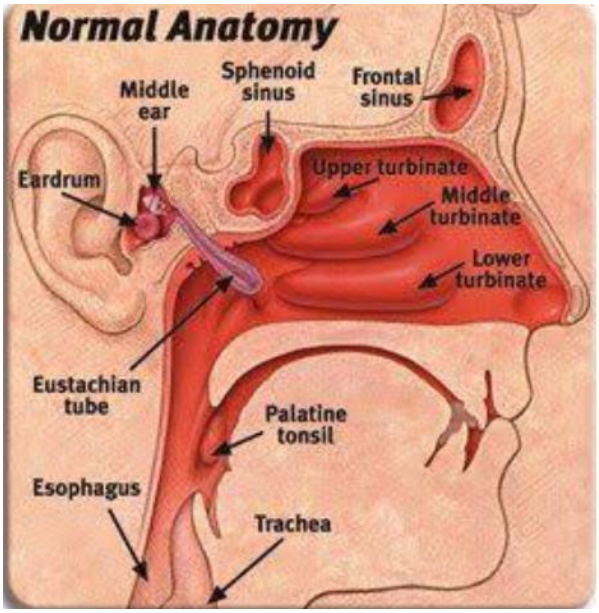
(i) Pharyngeal tonsil/adenoids

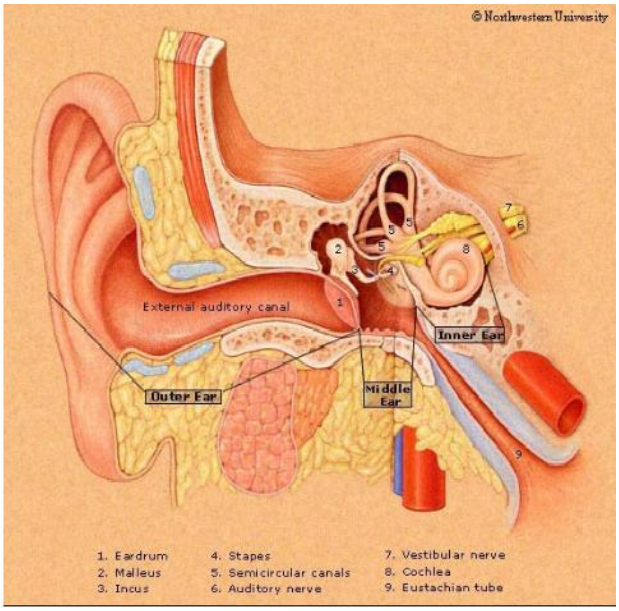
(ii) Tubal tonsil

(iii) Pharyngeal bursa

ANATOMY OF EUSTACHIAN TUBE

Eustachian tube is atrumpet shaped channel which connects the middle ear cavity with Nasopharynx. It is divided into three continuous portions: cartilaginous, junctional and osseous.





Length -36mm (adult) 18mm (children)

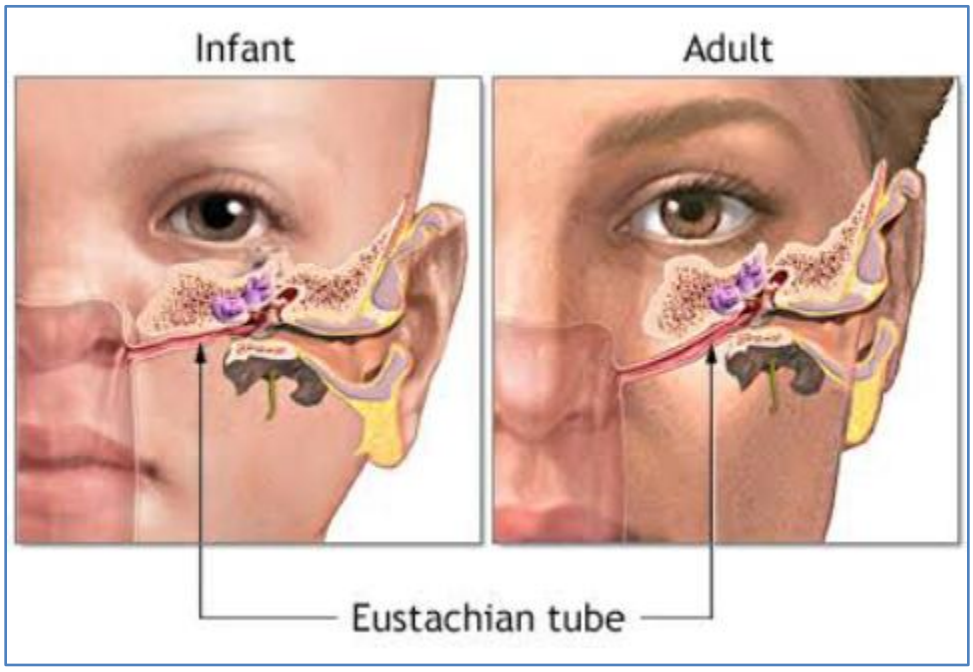
Parts –Medial part- Cartilaginous

Lateral part- Osseous part

Junctional Part

Direction- Downwards, forwards and medially

In children the tube is shorter due to small cartilaginous part, and more horizontal. Adult size of ET is attained at age of 7 years.



CARTILAGINOUS PART – is the proximal and opens into the nasopharynx. It is closely attached to the skull base and fitted in the sphenoid and petrous temporal bone, forming an angle of 30^0-34^0 to the transverse plane and $45^0$to the sagittal plane. The cartilage of the tube is inverted 'J' shaped in cross section. It is composed of short lateral lamina and bony medial lamina. Elastic fibres in the cartilaginous portion are concentrated near the dome and hinge portion of the tube. Elastic fibres help the lateral lamina to return to its original position after contraction.

OSTMANN PAD OF FAT- it is the fat tissue located in the inferolateral portion of the tube and aids in closing the tube. Fat pad increases in volume after birth.

BONY PART – also called Protympanic, Aural, Bony, or Middle ear portion of EustachianTube. This segment is completely within the petrous part of temporal bone. The junction of the osseous portion and epitympanum is 4 mm above the floor of tympanic cavity. The lumen is roughlytriangularand measures 2 to 3 mm vertically and 3-4 mmhorizontally. It is 12mm long and lies in the petrous temporal bonenear the tympanic plate. Lateral end is wider, oval in shape, 5*2mm in size, opens in the anteriorwall of middle ear. The medial end (isthmus) is narrow 0.6-1.2mm in diameter and 1-2mm in lengthattaches with the cartilaginous part. Lumen is oblong in shape being widest from side to side. The medial wall consists of 2 parts: posterolateral (labyrinthine) and anteromedial (carotid) mainly depends on the position of Internal Carotid artery. The mucosal lining of the Eustachian tube is similar to that of middle ear and includes both mucous producing glands and ciliated cells.

JUNCTIONAL PART – is the part of tube where cartilaginous and osseous portions connect. It is 3mm in length. The lumen of junctional portion increases from proximal to distal end.

ADULT ANATOMY- the length of adult Eustachian tube ranges from 31 to 38 mm. the average length of cartilaginous , junctional and osseous portions are 24mm, 3.0mm and 6mm respectively (average total length 33 mm) and forms an angle of 42^0 with parasagittal plane through medial pterygoid plate.

The tube takes a slowly curving inverted 'S' course from nasopharynx to middle ear. The nasopharyngeal end of Eustachian tube lies about 20mm above the hard palate. The cartilage protrudes into the nasopharynx known as Torus tubaris.

LUMEN OF THE TUBE- the osseous and cartilaginous portions of Eustachain tube lumen resemble two truncated cones attached at junctional area. The broadest ends representing the nasopharyngeal and tympanic orifice. The nasal orifice is 8.5mm in length and decreasesto 3.5mm after entering petrous temporal bone.

The narrowest portion of Eustachian tube is the isthmus and is not at the junctional portion as formerly thought. The isthmus lies at the distal part of cartilaginous portion (At 21mm from the pharyngeal orifice). The reduced caliber of the lumenat the isthmus is a critical component of physiological protective mechanism of Eustachian tube (i.e.,) the Flask effect.

MUCOUS MEMBRANE OF TUBAL LUMEN- the tubal lumen is lined by Pseudostratified ciliated columnar epithelium that sweeps secretions from middle ear to nasopharynx. The mucosal lining is continuous with lining of tympanic

cavity at distal end with nasopharynx at its proximal end. Goblet cells are associated with the ciliated epithelial cell and constitute 20% of cell population. Mucosa –associated –lymphoid tissue (MALT) is seen within the mucous membrane of cartilaginous portion of Eustachian tube.

BLOOD SUPPLY-

Five arteries contribute to the blood supply of Eustachian tube.

- Ascending palatine artery
- The pharyngeal branch of Internal Maxillary artery
- The artery of Pterygoid canal
- The ascending pharyngeal artery
- Middle meningeal artery

Venous drainage is via the pterygoid venous plexus.

LYMPHATICS OF THE TUBE: An extensive network of lymphatics seen in the tunica propria of the submucosa of the Eustachian tube and is more abundant in the cartilaginous portion than in the osseous portion. This network drains into either the retropharyngeal nodes medially or the deep cervical nodes laterally.

NERVE SUPPLY- (A) SENSORY – The pharyngeal orifice of the Eustachian tube receives innervation from Otic ganglion, sphenopalatine nerves and pharyngeal plexus. The remaining part of the tube receives innervation from the tympanic and the pharyngeal plexus. The glossopharyngeal nerve is the predominant nerve in tubal innervation.

(B) MOTOR – The tensor veli palatine and Tensor tympani are by Mandibular division of Trigeminal nerve. Thelevatorveli palatine muscle receives innervation from the Nucleus ambgues through the Vagus nerve.

(C)AUTONOMIC- Sympathetic innervation of the tube is by the sphenopalatine ganglion, the Otic ganglion, paired Glossopharyngeal nerves, the petrosal nerves and the caroticotympanic nerve. The parasympathetic nerve supply is derived from the tympanic branch of glossopharyngeal nerve.

MUSCLES ASSOCIATED WITH ET:

a) Tensor VeliPalatini
b) Tensor tympani
c) LevatorVeliPalatini
d) Salpingopharyngeus

The eustachian tube is passively closed at rest and opens during swallowing, yawning (or) sneezing allowing equalization of middle ear

and atmospheric pressures.

TENSOR VELI PALATINI is composed of two distinct bundles of muscle fibres. The tensor velipalatin and dilator tubae are divided by fibroelastic tissue. The tensor veli palatine originates from scaphoid fossa and greater wing of sphenoid, winds around pterygoidhamulus and gets inserted into posterior border of horizontal process of the palatine bone and palatine aponeurosis. The dilator tubae lies adjacent to the lateral membranous wall of Eustachian tube. It is important for the dilatation of the tube to equilibrate middle ear pressure during swallowing.

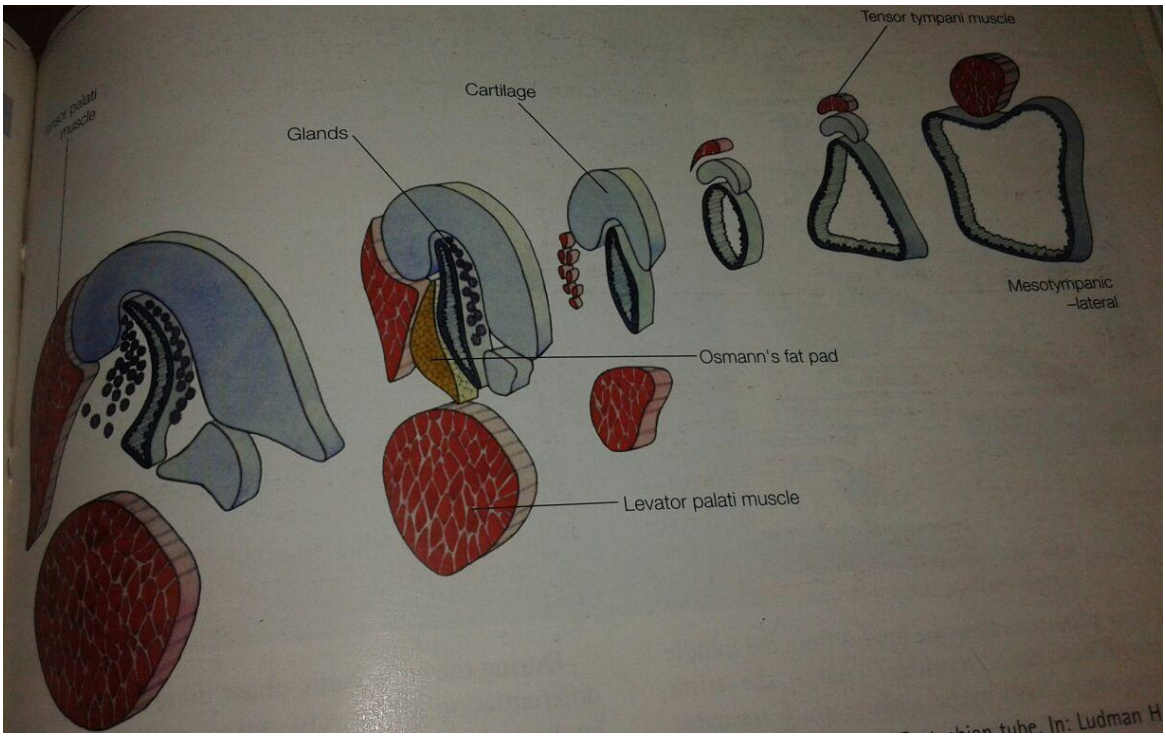
TENSOR TYMPANI – the tensor tympani muscle does not directly get involved in the active dilatation of the Eustachian tube. The stretch receptors in the tympanic membrane are related to modulation of middle ear pressure through tensor tympani and hence affect the tensor velipaltini to open the Eustachian tube.

LEVATOR VELI PALATINI muscle arises from the inferior aspect of petrous apex of temporal bone. The fibresliesparallel and beneath the tubal cartilage. It is inserted by fanning out and blending with the dorsal surface of the soft palate. The levatorisnot the primary dilator but ends its support by elevating the medial arm of cartilage at the nasopharyngeal end.

SALPHINGOPHARYNGEUS muscle arises from the medial and
inferior borders of tubal cartilage via muscular and tendinousfibres and

gets inserted by blending with the palatopharyngeal muscle. The muscle lacks any ability to perform physiological function

CROSS SECTION OF AUDITORY TUBE



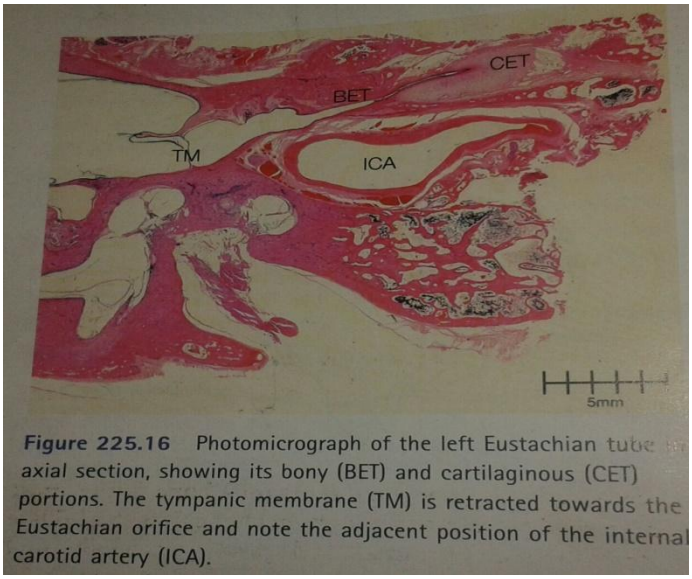


Figure 225.16 Photomicrograph of the left Eustachian tube in axial section, showing its bony (BET) and cartilaginous (CET) portions. The tympanic membrane (TM) is retracted towards the Eustachian orifice and note the adjacent position of the internal carotid artery (ICA).

HISTOLOGICAL PICTURE OF EUSTACHIAN TUBE

ANATOMY OF THE MIDDLE EAR

The middle ear is a narrow space situated in the petrous part of Temporal bone, between the external and internal ear. It communicates anteriorly with Nasopharynx through the auditory tube and posteriorly with mastoid air cell system through aditusadantrum.

Shape – Biconcave – compressed from side to side

Vertical dimension- 15mm

Anteroposterior dimension – 15mm

Transverse dimension – Upper part-6mm

Middle part-2mm

Lower part-4mm

CONTENTS OF MIDDLE EAR

Ossicles- Malleus, Incus and Stapes

Ligaments of Ossicles

Muscles – Tensor tympani and Stapedius

Vessels supplying and draining the middle ear

Nerves – Chorda tympani and Tympanic plexus

AIR

The mucous membrane lining the middle ear cavity invests all the contents and forms several mucosal folds which project into the cavity

BOUNDARIES OF MIDDLE EAR

A)Roof (or) Tegmen- it separates middle ear from middle cranial fossa, formed by Tegman tympani. The roof is prolonged forwards as the roof of canal for tensor tympano and backwards as the roof of mastoid antrum. It transmits a vein from the middle ear to the superior petrosal sinus.

B) Floor (or) Jugular wall- separates middle ear from Superior bulb of Internal Jugular Vein. Formed by thin jugular fossa.Transmits tympanic branch of Glossopharyngeal nerve passes through the tympanic canaliculus to the medial wall of middle ear cavity.

C) Anterior (or) Carotid wall- consists of 3 parts from superior to inferiorly as follows- opening of canal of tensor tympani, auditory tube opening and perforated by carotico-tympanic nerves and tympanic branch of internal carotid artery inferiorly.

The bony septum between the two semicanals for tensor tympani and auditory tube is continued posteriorly on the medial wall called processuscochleariformis. Its posterior end forms a pully for the tendon of tensor tympani.

D)Posterior (or) Mastoid wall- from above downwards by Aditusadantrum, Fossa incudis (lodges the short process of incus), Pyramid (or conical projection) with an opening at its apex for passage of stapedius muscle tendon and Posterior canaliculus for chorda tympani through which the nerve enters the middle ear cavity.

E) Lateral (or) membranous wall- formed by tympanic membrane along with tympanic ring and sulcus and partly by squamous temporal. Near tympanic notch there are two apertutes (i) Petrotympanic fissure – transmitting the tympanic branch of maxillary artery (ii) Anterior canaliculus for chorda tympani nerve

F) Medial (or) Labyrinthine wall- presents the following

(i) Promontory – bulge produced by basal turn of cochlea and grooved by tympanic plexus

(ii) Fenestra vestibule is an oval opening posterosuperior to promontory, closed by footplate of stapes

(iii) Prominence of facial canal running backwards just above the fenestra vestilbuli towards the lower margin of aditus

(iv) Fenestra cochlea is a round opening at the bottom of a depression posteroinferior to promontory closed by secondary tympanic membrane

(v) Sinus tympani- is a depression behind promontory opposite to ampulla of posterior semicircular canal.

ARTERIAL SUPPLY

a) Anterior tympanic branch of maxillary artery enters through the petrotympanic fissure
b) Posterior tympanic branch from stylomastoid branch of posterior auricular artery enters through the stylomastoid foramen.
c) Superior tympanic branch from middle meningeal artery
d) Inferior tympanic branch from ascending pharyngeal artery
e) Tympanic branch from the artery of pterygoid canal
f) Caroticotympanic branch from internal carotid artery
g) Petrosal branch from middle meningeal artery

VENOUS DRAINAGE- into the superior petrosal sinus and pterygoid plexus of veins.

LYMPHATIC DRAINAGE- into preauricular and retropharyngeal lymph nodes.

NERVE SUPPLY- by tympanic plexus over the promontory formed by the tympanic branch of glossopharyngeal nerve and superior and inferior caroticotympanic nerves (Sympathetic plexus)

MASTOID ANTRUM

It is a small circular shaped air space situated in the posterior part of petrous temporal bone bounded by tegmen superiorly, mastid part of temporal bone inferiorly, communicates anteriorly with epitympanicrecesss through aditusadantrum, by sigmoid plate and sinus posteriorly and by MacEwan's triangle laterally. Its arterial supply is by posterior tympanic artery from stylomastoid branch of posterior auricular artery. Venous drainage into emissary vein posterior auricular vein and sigmoissinus.Lymphatic drain into post auricular and deep cervical lymph nodes. Nerve supply from tympanic plexus andmeningeal branch of mandibular nerve.

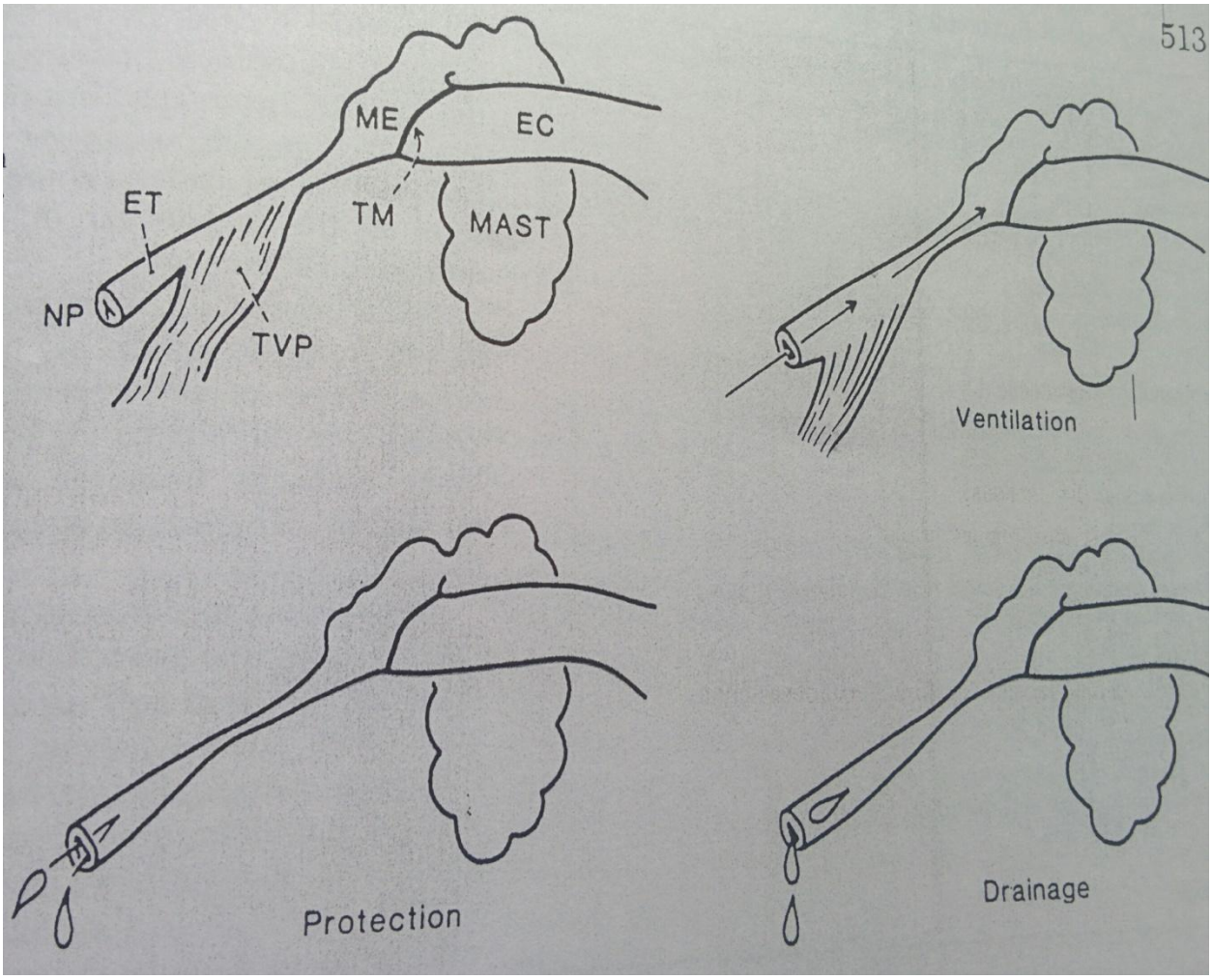
PHYSIOLOGY OF EUSTACHIAN TUBE

The three main functions of Eustachian tube are

1) pressure regulation (ventilation) of the middle ear

2) protection of middle ear

3) clearance (drainage) of secretions in the middle ear



VENTILATION

Of the three functions of the Eustachian tube the most important is the regulation of middle ear pressure (ventilation) .hearing is optimal only when the middle ear pressure is the same as the External Auditory Canal pressure. The intermittent opening of the Eustachian tube occurs while swallowing with the contraction of Tensor veli palate muscle. This maintains the ambient middle ear pressure. The resting middle ear pressures of normal adult ranges between 50 to -50 mm H20. Children have less efficient Eustachian tube function than adult.

PROTECTION

Eustachian tube protects middle ear and mastoid air cell system in two ways

1) by its functional anatomy
2) immunologic and mucociliarydefence mechanism

Protection of middle ear from abnormal nasopharyngeal secretions and sound pressure is dependent on the normal anatomical structure and function of Eustachian tube. It also depends on the middle ear and mastoid air cell system to maintain a gas cushion. The middle ear and mastoid air cell system are lined by respiratory epithelium with local immunological defense and mucociliary clearance, at rest the Eustachian tube is collapsed and tubal lumen is collapsed.

This prevents nasopharyngeal secretion and sound pressure to enter the nasopharyngeal end.

During swallowing when the proximal end (cartilaginous portion) ofEustachian tube opens, liquid can enter up to this portion but does not enter the middle ear due to narrow isthmus midportion of Eustachian tube.

This is better explained by the Flask model of protection.

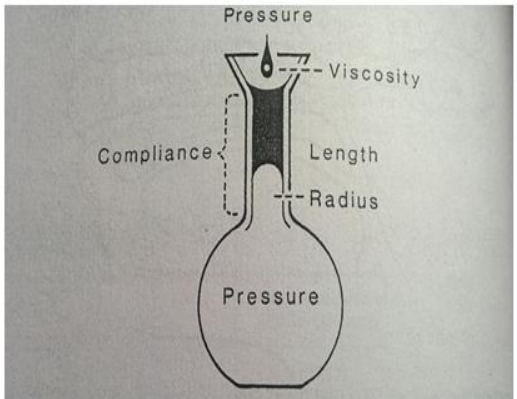


FIGURE 25–23. Flask model of the eustachian tube–middle ear–mastoid air cell system. The mouth of the flask represents the nasopharyngeal end of the eustachian tube, the neck is the cartilaginous portion of the tube, and the bulbous portion represents the middle ear and mastoid air cells (see text).

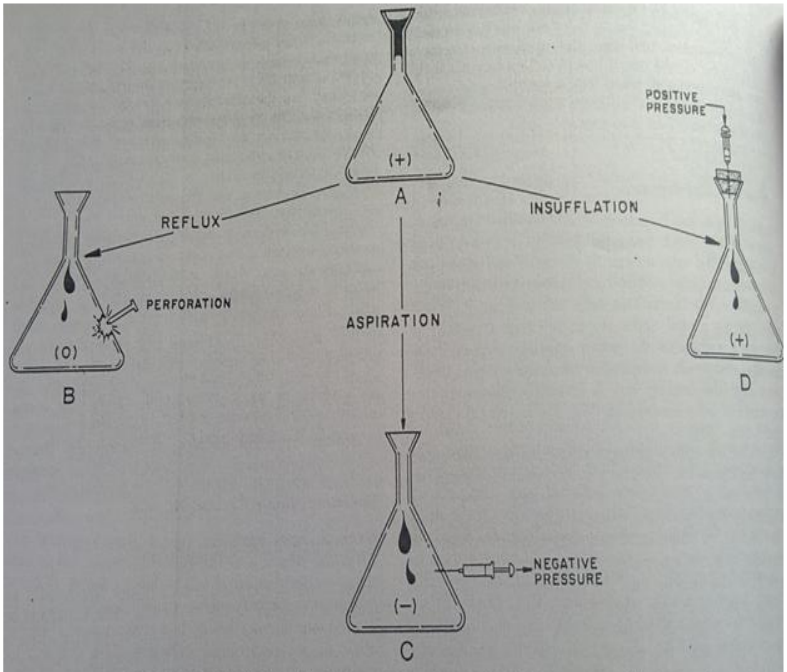


FIGURE 25–29. The flask model of the middle-ear system for fluid flow. *A*, Model of normal function. *B*, Effect of perforation. *C*, Effect of negative pressure on the bottom of the flask. *D*, Effect of positive pressure on the mouth of the flask (see text). (From Bluestone CD, Klein JO. Otitis Media in Infants and Children, 3rd ed. Philadelphia, WB Saunders, 2001,

CLEARANCE FUNCTION

The drainage of secretions from the middle ear into the nasopaharynx is done by the

1) mucociliary clearance and

2) muscular clearance

The middle ear and Eustachian tube lumen are lined by respiratory epithelium. The mucociliary lining of the Eustachian tube clears the secretion of the middle ear aided by the pumping action of the Eustachian tube during closing.

Ciliated cells in the middle ear are more active as they come more distal to the opening of the tube. The passive closing of Eustachian tube starts at the middle ear and gradually progresses towards the nasopharyngeal end and then pumping out the middle ear secretion from Eustachian tube.

Surface tension within the lumen of Eustachian tube also plays an important role in normal functioning of Eustachian tube.

PATHOPHYSIOLOGY OF EUSTACHIAN TUBE

Classified into

1) impairment of pressure regulation

2) loss of protective function

3) impairment of mucociliary clearance

IMPAIRMENT OF PRESSURE REGULATION

Impairment of middle ear pressure regulation may be due to anatomical obstruction of Eustachian tube (to closed) or functional obstruction (failure to open) of the Eustachian tube.

ANATOMICAL OBSTRUCTION

The anatomical obstruction may be at osseous portion or cartilaginous portion of the tube. The middle ear mucosal inflammation and cholesteatoma, polyps of middle ear can lead to obstruction at distal end of the tube. Adenoid, foreign body (pack),tumours of Nasopharynx may lead to obstruction at proximal end.

FUNCTIONAL OBSTRUCTION

This is due to failure of opening of cartilaginous portion of Eustachian tube during swallowing. This may be caused by

1) due to increased compliance of the tube leading to persistent collapse of the tube
2) ineffective opening mechanism
3) combined effect

The persistent collapse is attributed to less cartilage portion seen in infantile and an inefficient tensor veli palatine muscle.

LOSS OF PROTECTIVE MECHANISM

The reasons for loss of protective mechanism are

1) the lumen of the Eustachian tube is abnormally patent

2) the length of the eusatachian tube is too short

3) development of abnormal air pressure at either ends of tube

4) non intact middle ear e.g:perforation of Typmanic membrane or tympanostomy can lead to loss of middle ear gas cushion effect

IMPAIRMENT OF MUCOCILIARY CLEARANCE FUNCTION

Drainage of secretion from the middle ear and Eustachian tube can be affected by bacteria, their toxin and mediation which can impair ciliary function

Allergy does not impair mucociliaryfunction but can alter the mucous blanket in the Eustachian tube.

OTHER CAUSES OF ET DYSFUNCTION

Eustachian tube dysfunction associated with

- deviated nasal septum
- trauma caused by Nasogastric and Eustachian tube
- trauma to palate , pterygoid bone and tensor velipalati muscle
- injury to mandibular branch of Cranial nerve V

- trauma associated with surgical procedure like maxillary resection of tumor
- benign or malignant disease invading palate

TESTS FOR EVALUATION OF EUSTACHIAN TUBE FUNCTION

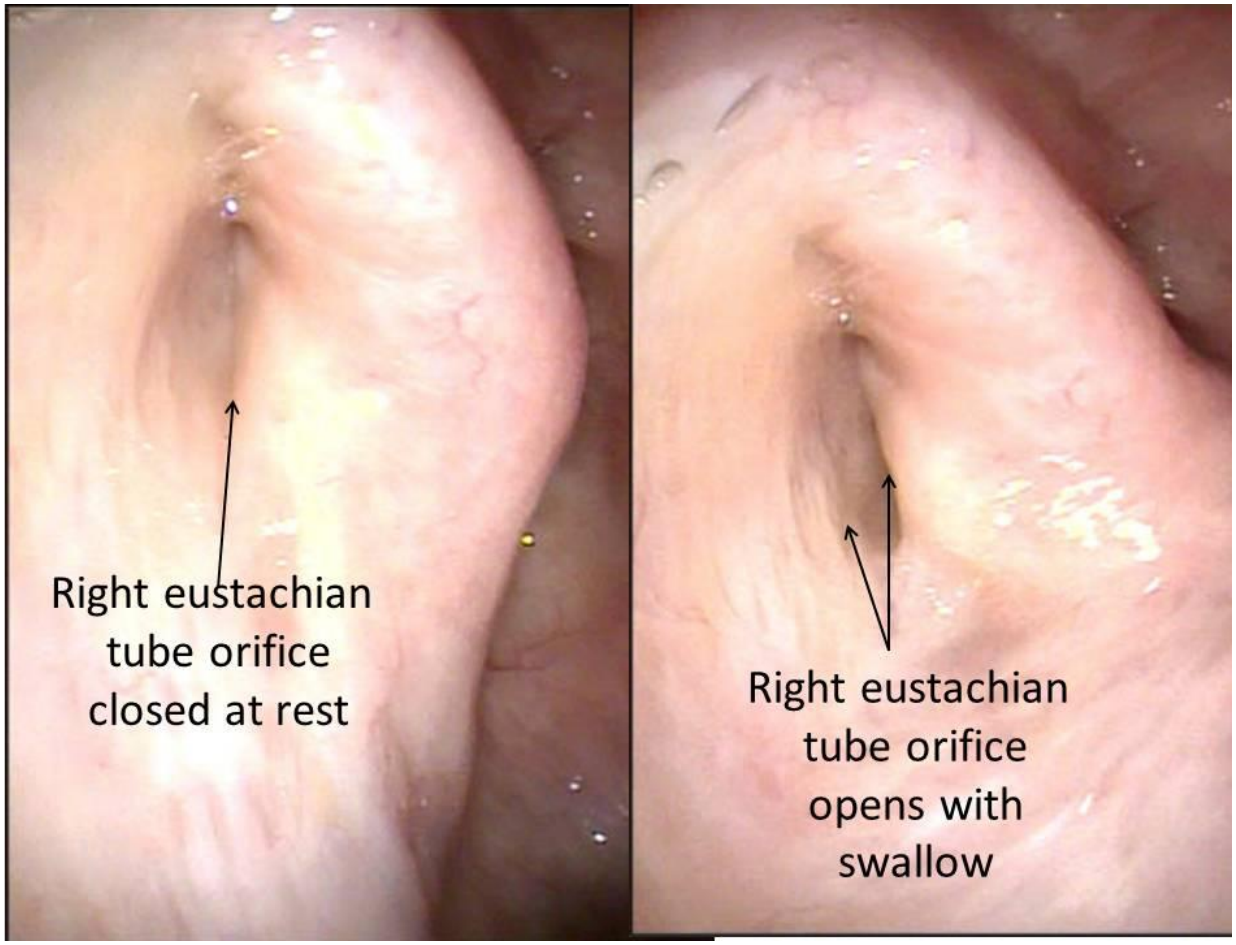
The methods to assess the ventilatory function of Eustachian tube are by following tests:

OTOSCOPY

Examining the Tymanic membrane by using pneumatic otoscope in one of the simplest and easiest way of testing Eustachian tube function. By doing otoscopic examination one can assess the middle ear effusion and high negative middle ear pressure (retracted tympanic membrane). But Eustachian dysfunction like patulous orsemipatulous ET could not be diagnosed as it appears like normal Tympanic membrane.

NASOPAHARYNGOSCOPY AND NASAL ENDOSCOPY

Visualization of the nasopharyngeal end of Eustachian tube is an important test of ET function.



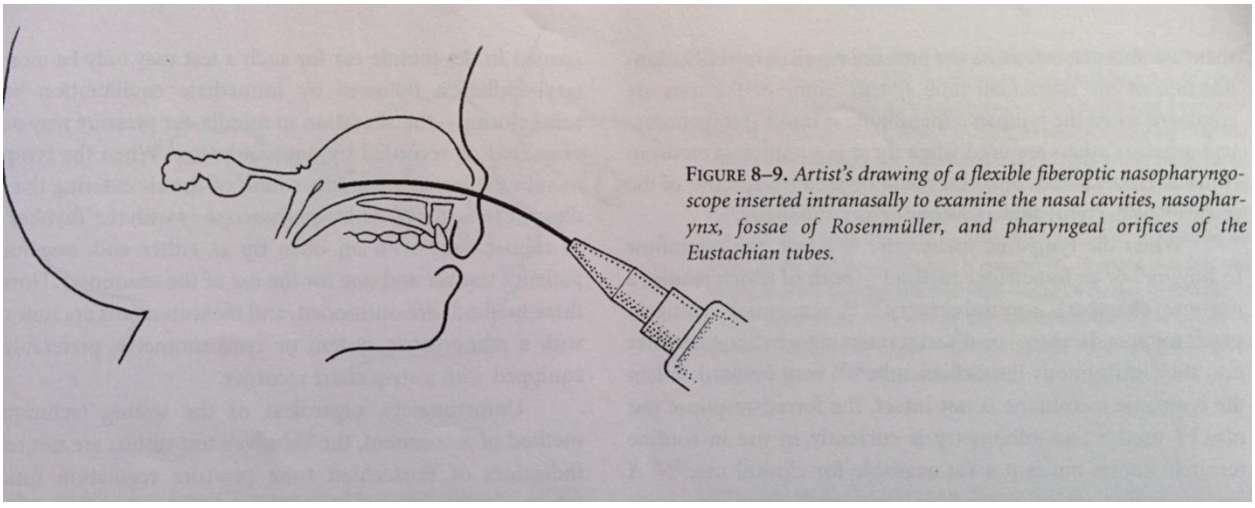
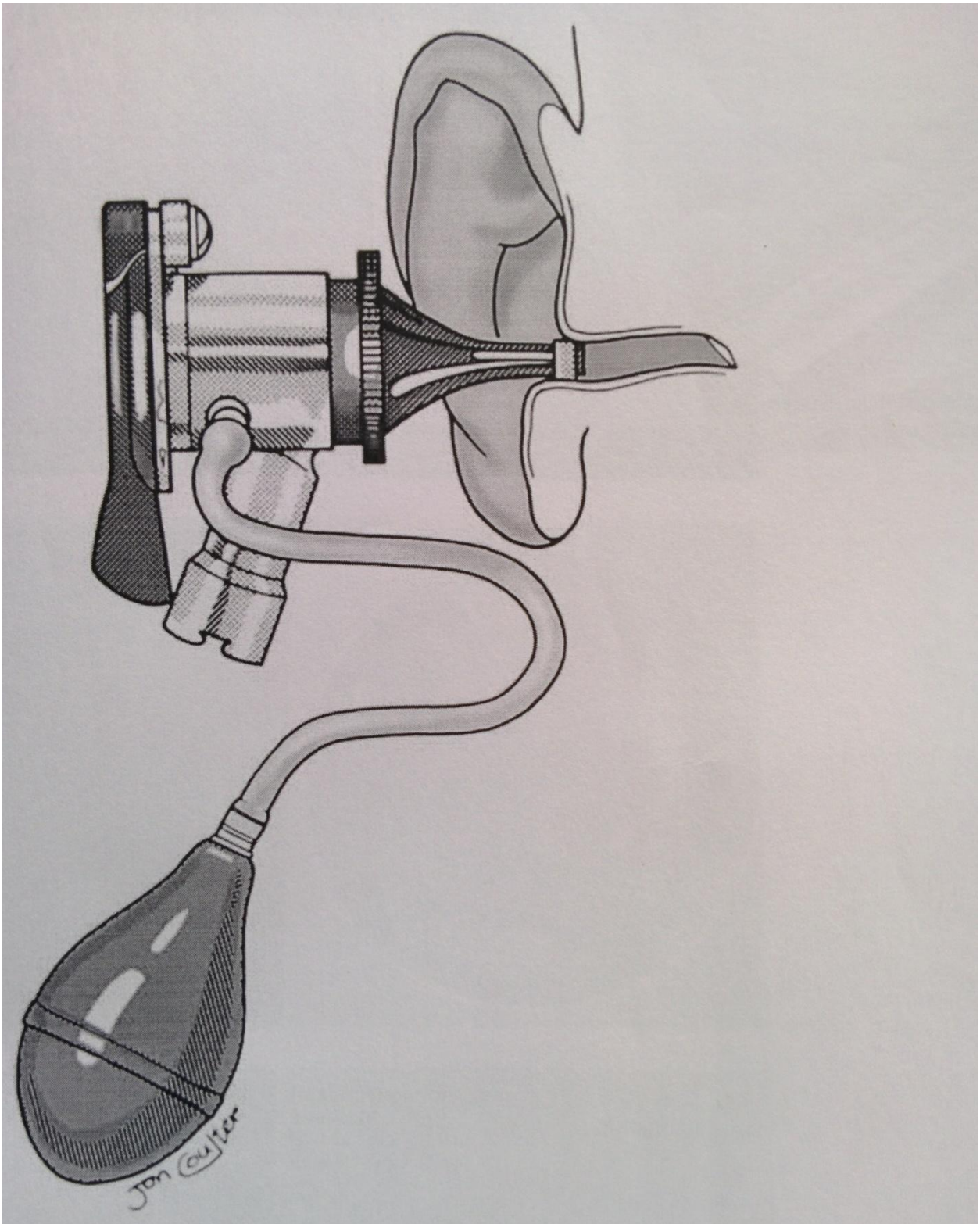


FIGURE 8–9. *Artist's drawing of a flexible fiberoptic nasopharyngoscope inserted intranasally to examine the nasal cavities, nasopharynx, fossae of Rosenmüller, and pharyngeal orifices of the Eustachian tubes.*



Pneumatic otoscope with piece of rubber tubing on tip of peculum when meatus is large for adequate seal.

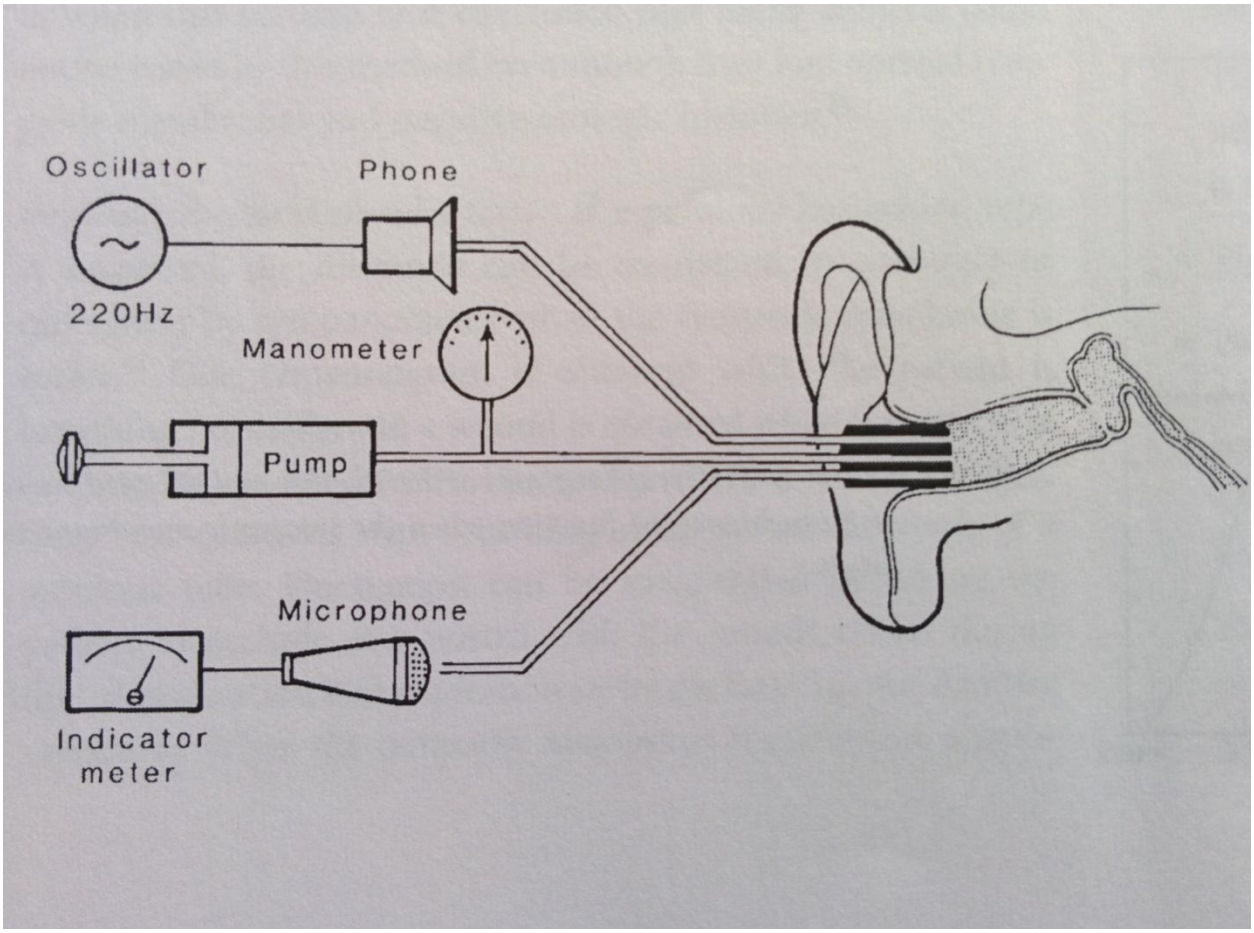
This can be done by conventional mirror exam or modern endoscopes which are more precise . By this a tumor in the Fossa of Rosenmuller and the structure of Eustachian tube can be diagnosed easily.

TYMPANOMETRY

Tympanometry is an excellent method to assess the tympanic membrane and middle ear system and thereby the functioning of Eustachian tube. This test detects middle ear effusion and negative middle ear pressure accurately in an objective manner. But there may be high negative pressure in some children who are asymptomatic. Hence a restingpressure that is highly negative suggests Eustachian tube obstruction but presence of normal tympanogram does not necessarily exclude Eustachian tube dysfunction. In cases of Patulous Eustachian tube dysfunction, normal tympanogram can be obtained.

MANOMETRY

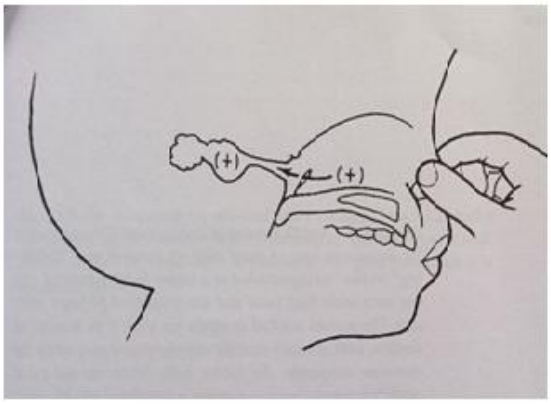
The pump-manometer system is used to assess the Eustachian tube function clinically if the Tympanic membrane is not intact. The Eustachian tube opening pressure should exceed +400 to +600mm H20.



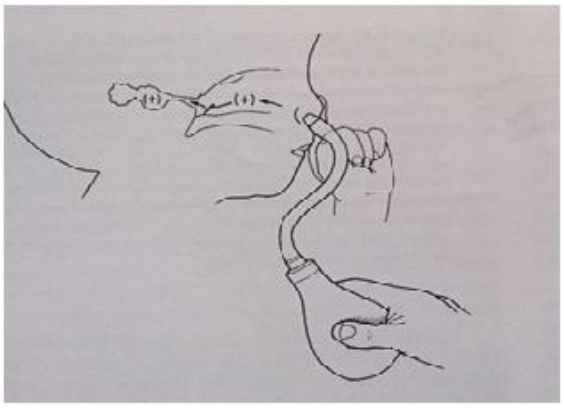
CLINCAL TESTS OF TUBAL PATENCY

Valsalva and Politzer developed methods to assess the Eustachian tube patency. These methods assessed by tymanogram are efficient if the Tympanic membrane is intact. If tympanic membrane is not intact passage of air in middle ear indicates Eustachian tube patency. This is assessed by manometer of Impedance Bridge.

Valsalva's test



Politzer's test

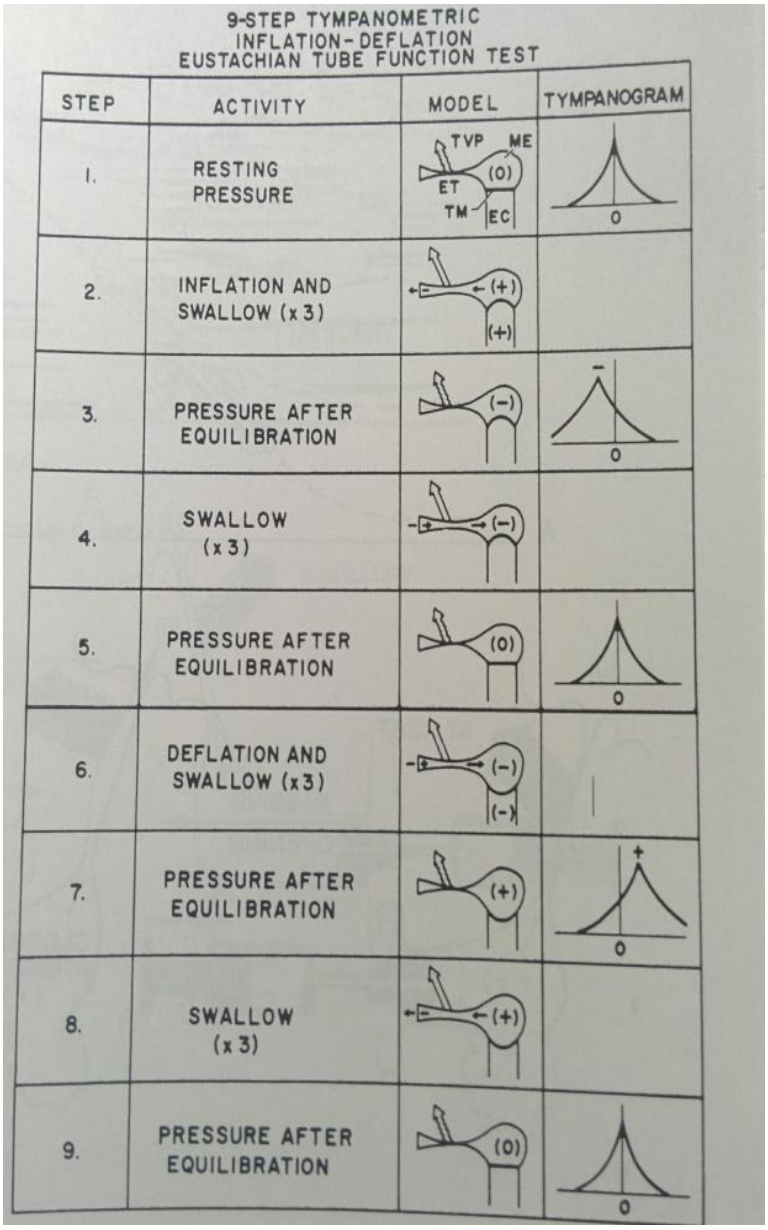


TOYNBEE TEST

Toynbee's test is one of the best to assess Eustachian tube patency. Swallowing with closed nostrils, development negative pressure is positive test. This is evident bypneumaticotoscopy or by doing tympanogram before and after the test, if the Tympanic membrane is intact. If the Tymapanic membrane is not intact the test result can be obtained by observing in manometer of impedance bridge.

NINE STEP INFLATION-DEFLATION TYMPANOMETRIC TEST:

Bluestone developed a nine step test to study the Eustachian tube function if Tympanic membrane is intact.



MODIFIED INFLATION-DEFLATION TEST (NON-INTACT TM):

When the Tympanic membrane is not intact, the pump manometer system of impedance audiometer is used to do Modified Inflation –Deflation test. To perform this test the middle ear should be free of any drainage.

A positive pressure is given to the middle ear and the Eustachian tube passively opened. The pressure at which the Eustachian tube opens isthe opening pressure and the pressure at which the Eustachian tube closes passively is the closing pressure. Then the patient is asked to swallow to equilibrate the residual middle ear pressure.

If the Eustachian tube is not opened with this Electroacoustic impedance audiometer then another manometric system is used which increases pressure more than 400mmH2O.

The mean opening pressure for normal subjects with traumatic perforation is 330mm H2O (+70). If the tube does not open to 1000mmH2O there is total mechanical obstruction. A high opening pressure of 500mm to 600mmH2O suggests partial obstruction. A low opening pressure of <100mm H2O indicates a semipatulous Eustachian tube.

EUSTACHIAN TUBE CATHETERISATION:

- The tip of the catheter is inserted into the nose and passed along the floor of the nasal cavity till it touches the posterior pharyngeal wall. The tip is now in the nasopharynx.
- It is then rotated 90° medially and drawn forward till it meets resistance. The tip is now touching the posterior free end of the nasal septum.
- At this point, the tip is rotated 180° laterally so that it enters the opening of the Eustachian tube in the lateral wall.
- A Politzer bag is attached to the other end of the catheter. Air pushed from it can be heard rushing into the ear if the Eustachian tube is patent.

RADIOGRAPHIC STUDIES OF PROTECTIVE AND CLEARANCE FUNCTION

The clearance and drainage functions of eustachian tube are assessed by many methods. Radiographic technique has been used by Welin, Aschen, Compere, Parisier and Kliani, Bluestone, Ferber and Holmquist. In this technique flow of contrast material from the middle ear to Nasopharynx (if tympanic membrane is not intact) is assessed. Rogersinstille fluorescein into the middle ear and assessed clearance by examining Nasopharynx with Ultraviolet light. Bauer et al, used methylene blue for this purpose.Elbrod and Larsen used Saccharin for this test.

Radiographic material instilled through nose and retrograde flow from Nasopharynx to middle ear was studied. In patient with normal protective function the radio-opaque material entered only the nasopharyngeal end or the isthmus of Eustachian tube and never into the bony portion of Eustachian tube or middle ear.

TESTS FOR VENTILATORY FUNCTION

The tests used if Tympanic membrane is intact are the microflow technique, impedance audiometry, sonotubometry, sequential scintigraphy, microendoscopy, or inserting a balloon catheter into the cartilaginous Eustachian tube. If Tympanic membrane is non-intact, the forced response test can be cured.

MATERIALS AND METHODOLOGY

MATERIALS

Study place : Rajiv Gandhi Government General Hospital, Chennai-600003

Collaborating Department : Upgraded Institute of Oto-Rhino – laryngology

Study Design : Prospective and Retrospective

Study Period : September 2014 to October 2015

Ethical Clearance : Obtained

Inclusion Criteria

1. CSOM (All tubotympanic type)

Exclusion criteria

1. Congenital anomaly
2. Atticoantral disease
3. Age <12 years
4. Serous Otitis Media

Investigations

1. Plain X-ray both mastoids
2. Pure tone audiometry
3. Impedance audiometry
4. Oto-endoscopy
5. Dye instillation test
6. Diagnostic nasal endoscopy

Data collection : Clinical

Benefit to the community:

1. To study the association between Eustachian tube function and graft uptake in our community

2. To know the incidence of Eustachian tube dysfunction in CSOM (tubotympanic) patients in our community

Conflict of Interest : NIL

Financial support : NIL

Principal investigator : Dr.M.Yoganandh MS (ENT) postgraduate

METHODOLOGY

The study was conducted in Rajiv Gandhi Government General Hospital and Madras Medical College in the Upgraded Institute Of Oto-Rhino-Laryngology.

The study group comprised of patients who were diagnosed to have CSOM of tubotympanic type. Detailedhistory and clinical examination as per the proforma were performed.

The patients were subjected to a complete otolaryngological examination to rule out any associated pathologies and foci of sepsis, which could influence the result of tympanoplasty. Each patient was subjected to blood investigation, pus culture and sensitivity, plain X-ray both mastoids. Pure tone audiometry, impedance audiometry and Diagnostic nasal endoscopy.

ASSESSMENT OF EUSTACHIAN TUBE FUNCTION

In our institute the assessment of Eustachian tube function is done at Institute of Speech and Hearing.

FORCED INFLATION TEST

In CSOM patients with non-intact Tympanic membrane the forced inflation test is done to assess Eustachian tube function. The probe of manometer is fitted to test ear and middle ear pressure is raised to 500dPa. This opens the Eustachian tube

and pressure drops. This passive opening of Eustachian tube is called opening pressure. After the pressure is equilibrated the Eustachian tube closes and this is called as closing pressure. If there is no passive opening of Eustachian tube, then the patient asked to swallow 3-5 times. This will open the Eustachian tube and then the pressure drop occurs. This is active opening of the Eustachian tube. This is considered as a positive test.

If the Eustachian tube doesn't open even after swallowing, then it is negative. Positive test suggests normal functioning of Eustachian tube and Negative test suggests grossly impaired Eustachian tube function.

IMPEDANCE AUDIOMETRY

In our institute, we use resonance R36 M to evaluate Eustachian tube function in perforated drum.

resonance

r36m

CLINICAL MIDDLE EAR ANALYZER

PRODUCT SPECIFICATIONS

GENERAL SPECIFICATIONS

DIMENSIONS AND WEIGHT:
- L x W x H: 370x290x180 mm
- Net weight: 3.5 kg
- Body material: Bayblend® self-extinguishing

TEST TYPES:
Tympanometry, Acoustic Reflex, Reflex Decay, nr. 3 Quick Test, Acoustic Reflex Latency Test (ARLT), ETF (Intact and Perforated), Special tests (Growth-DU and Non acoustic), Multifrequency Tympanometry (R36M-PT)

DISPLAY:
- 7" TFT Color display

USER INTERFACE:
- Multilingual

PRINTER:
- Built-in fast thermal printer with paper width: 112 mm supplied as standard part

REPORTS:
- Printed on thermal printer
- .pdf report create directly from the device and stored on USB Pen drive with possibility to add patient data and tests comments via the USB Keyboard (optional)
- Data transfer to PC using Resonance Management Data Suite

"CHILDREN" FEATURE:
- To help keep the child distracted while running screening "Quick Check" or "Tympanometry HF", a series of animated images appears on the color display

DATA TRANSFER TO PC:
- Via cable trough USB port

COMMUNICATION PORT:
- Nr.1 USB host type A
- Nr.1 USB slave type B

TYMPANOMETRY OPERATING SPECIFICATIONS

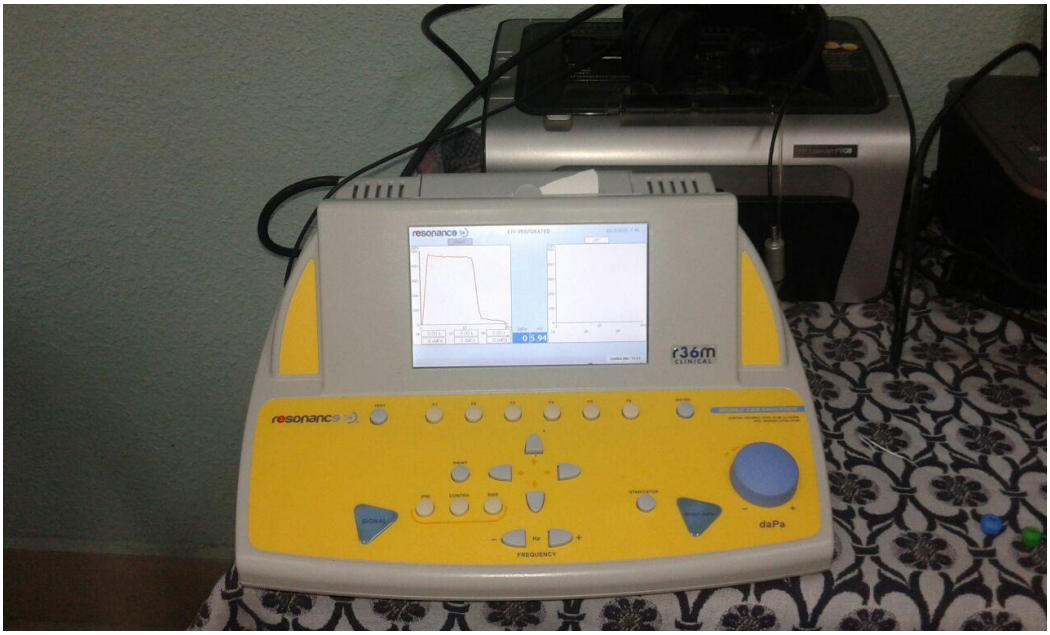
PROBE TONE
- 226 Hz for traditional Y-curve tympanometry
- 226 Hz for traditional Y-curve tympanometry (R36M-PT)
- 678, 800 and 1000 Hz for traditional Y-curve tympanometry with added "B" and "G" curve (R36M-PT)

INTENSITY
- 226 Hz: 85dB SPL ± 2dB
- 678, 800 and 1000 Hz: 75dB SPL ± 2dB
- Frequency Accuracy: ± 0,5%
- Harmonic distortion: Less then 1%

ADMITTANCE MEASUREMENTS
- 226 Hz: 0 to +5ml
- Sensitivity scale: Auto Scales to appropriate range, available scales 1.5, 2 and 5ml
- 678, 800 and 1000 Hz: 0 to +25 mmho
- Sensitivity scale: Auto Scales to appropriate range, available scales 5, 10, 15, 20, 25 mmho
- Compliance range: from 0,1 up to 5 ml

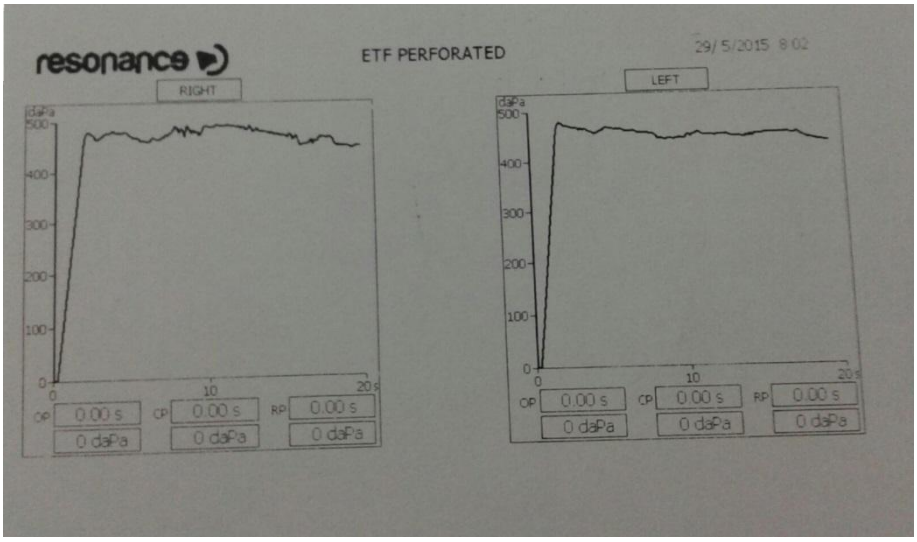
AIR PRESSURE
- Control: Automatic and Manual
- Range: from +400 up to -600 daPa adjustable in 50 daPa steps
- Pressure accuracy: +/- 10 daPa or +/- 10%
- Sweep rate: 50, 100, 200,300 daPa/sec and automatic
- Indicator: Measured value is displayed on the
- graphical display
- Safety limitations: -800 up to +600 daPa

EUSTACHIAN TUBE FUNCTION
- ETF test for use with both intact and perforated eardrums

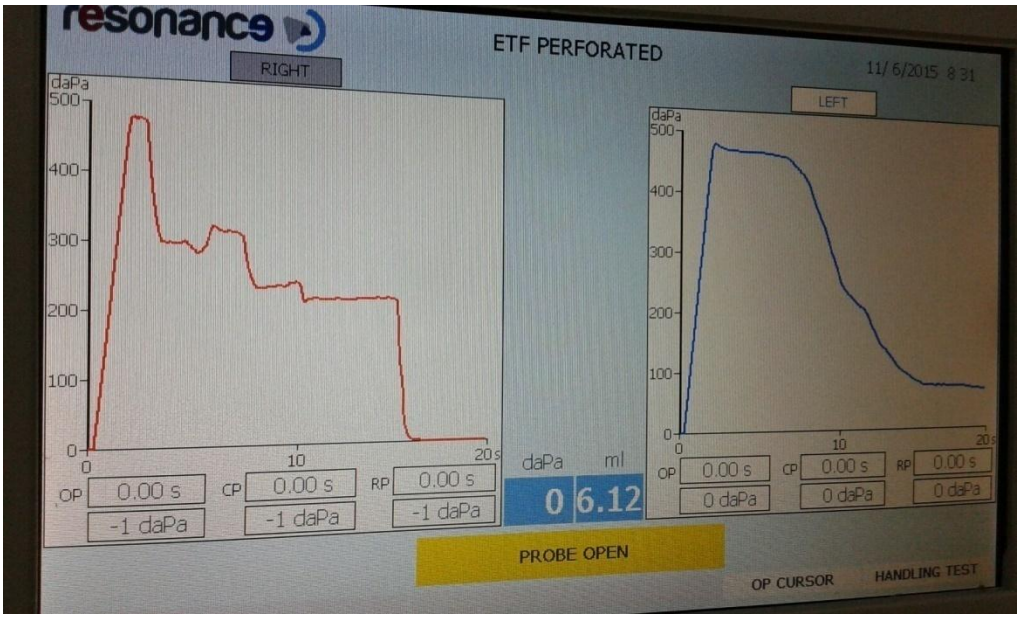


Impedenceaudiometry test being done in a patient with CSOM to test ETF(non intact TM).

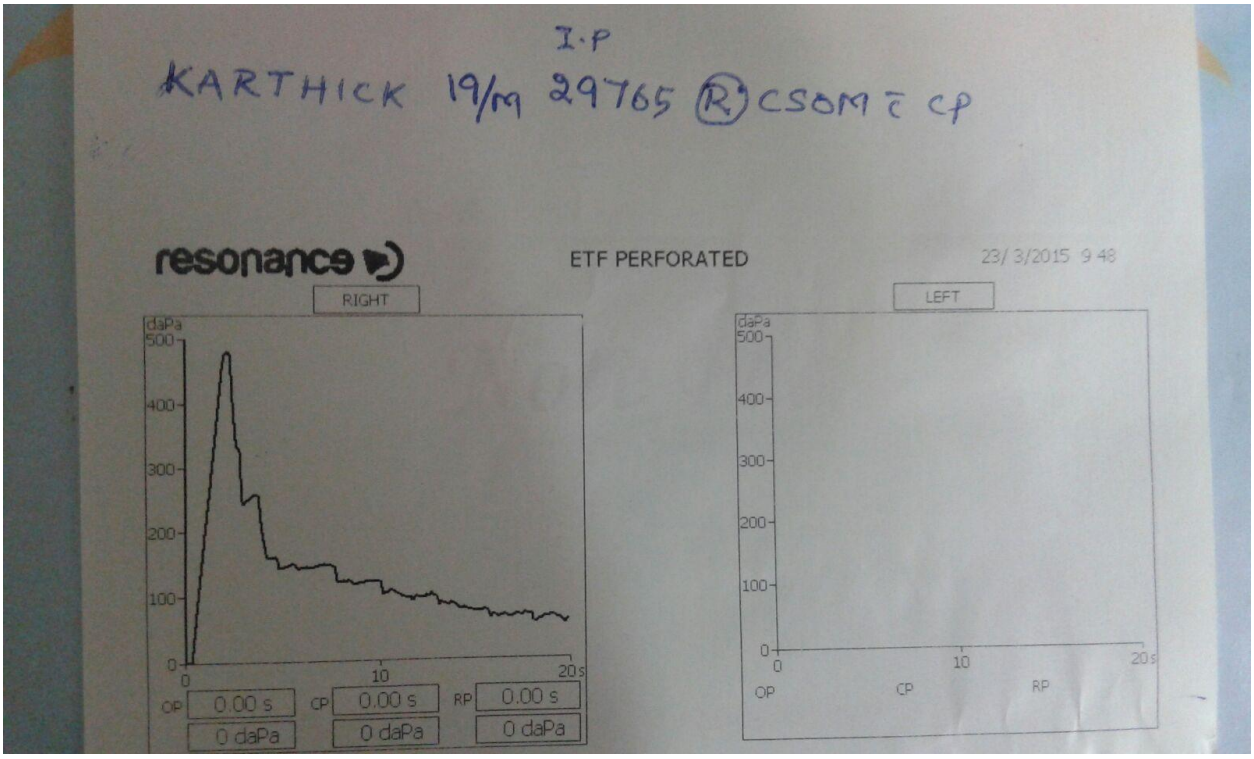
Impedence audiometry test being done in a patient with CSOM to test ETF(non intact TM).



Severe Eustachian tube dysfunction in a patient with bilateral CSOM with CP.



Normal Eustachian tube function in a patient with right CSOM with CP.



Normal Eustachian tube function in a patient with right CSOM with CP.

DYEINSTILLATIONTEST

The mucociliary mechanism of Eustachian tube assessed by dye test. The patients were then subjected to dye instillation test.

0.25 mL of Methylene blue dye is instilled into the test ear and the test ear was kept upwards for 5-10 minutes. Then by nasal endoscopy the nasopaharyngeal end of Eustachian tube was visualized after spraying 4% xylocaine. The nasopharyngeal end was watched for appearance of dye. At the end of 5 minutes if dye did not appear,tragal pressure was applied at 30seconds interval and a note was made of number of tragal pressures after which dye appeared.

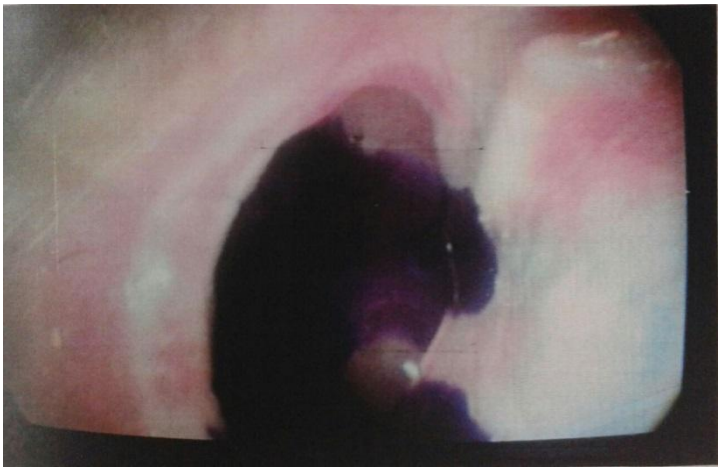
a) Normal function : dye appears in 5 minutes and upto 6 tragal pressures

b) Hypofunction : dye appears after 7 to 20 tragal pressures

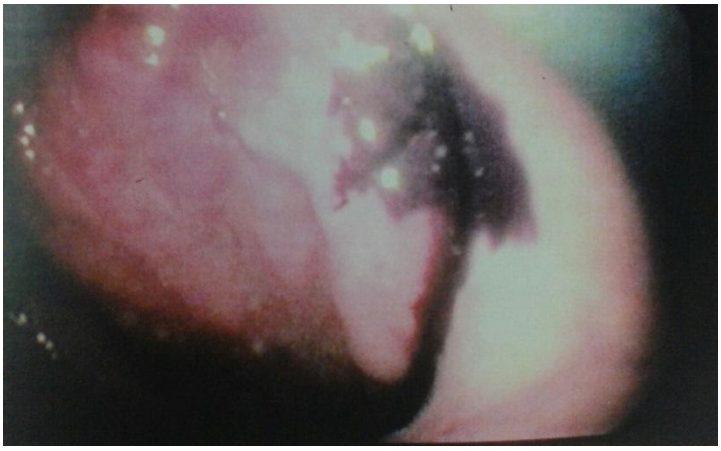
c) Obstruction : dye fails to appear even after 20 tragal pressures

RIGHT CENTRAL PERFORATION SEEN

DYE INSTILLED INTO THE MIDDLE EAR



DYE SEEN IN THE EUSTACHIAN TUBE ORIFICE



SURGICAL PROCEDURE

After assessment of Eustachian tube function, patients were taken upfor myringoplasty or cortical mastoidectomy depending upon the middle ear status. Antibiotics were given for 1 week along with analgesics, antihistamines and multivitamins. Sutures were removed on the 7th Post-operative day.

POST OPERATIVE FOLLOW UP

Patients were reviewed 2 weeks after discharge and 2nd and 3rd review on the 1st and 3rd month post operatively. Patients were evaluated post-operatively using otoscopy.

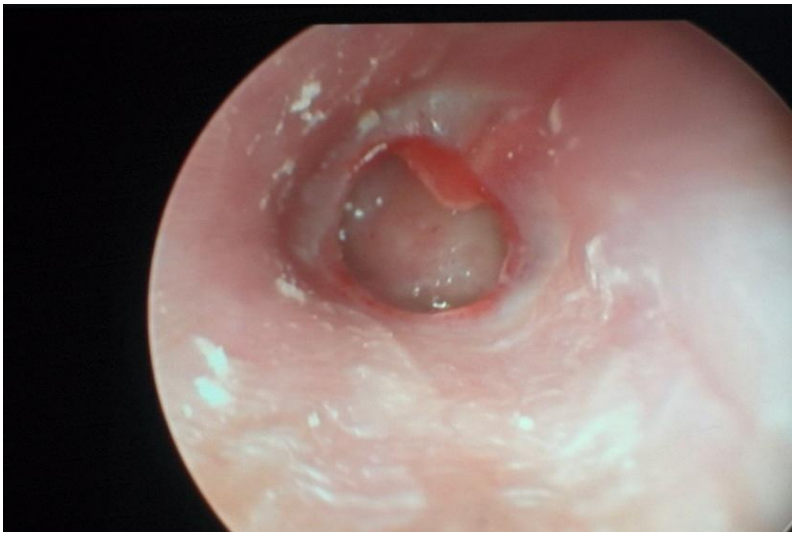
OUTCOMES

On the basis of ear findings in post-operative period patients were divided into two outcomes

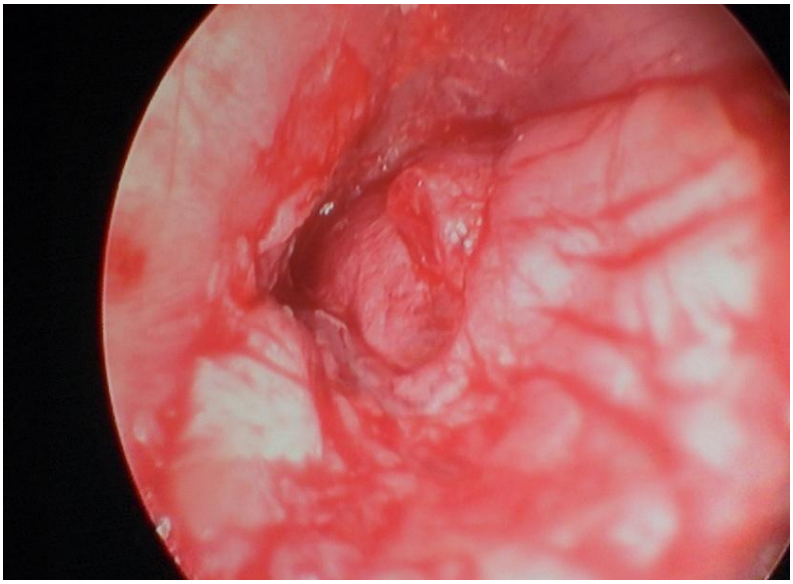
1. Successful outcome, defined as healed graft with good middle ear function
2. Graft failure or perforation secondary to Otitis media during follow is considered as failure.

CASE STUDY 1

Pre op picture

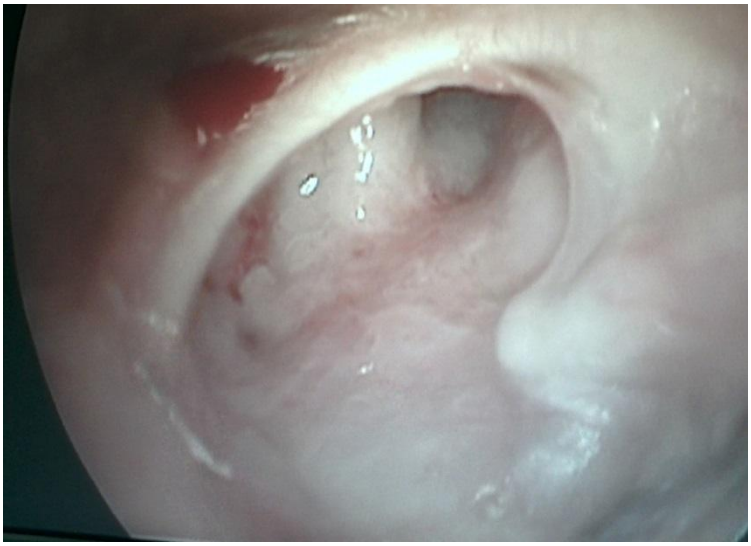


Intra op picture



CASE STUDY 2

Pre op picture



Intra op picture

STASTICAL ANALYSIS AND RESULTS

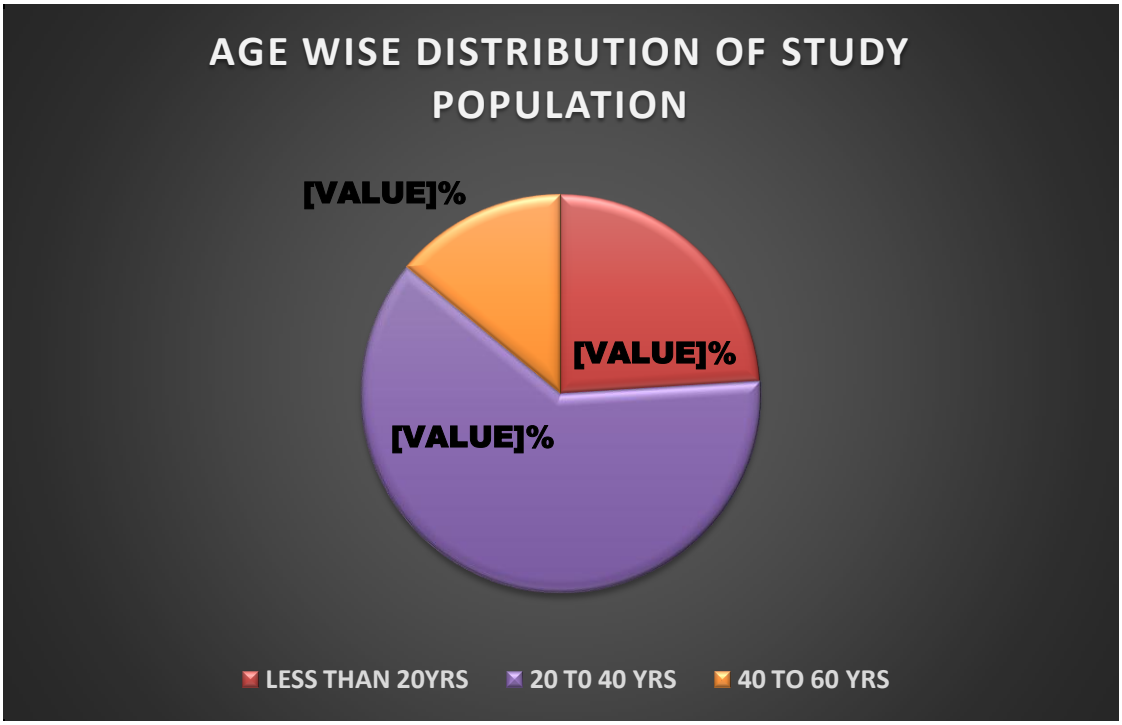
Data entered in Microsoft office excel.

Analysis was carried out using SPSS for windows version 16.

Relevant results tabulated.

Chi-square test was used to analyze the variable.

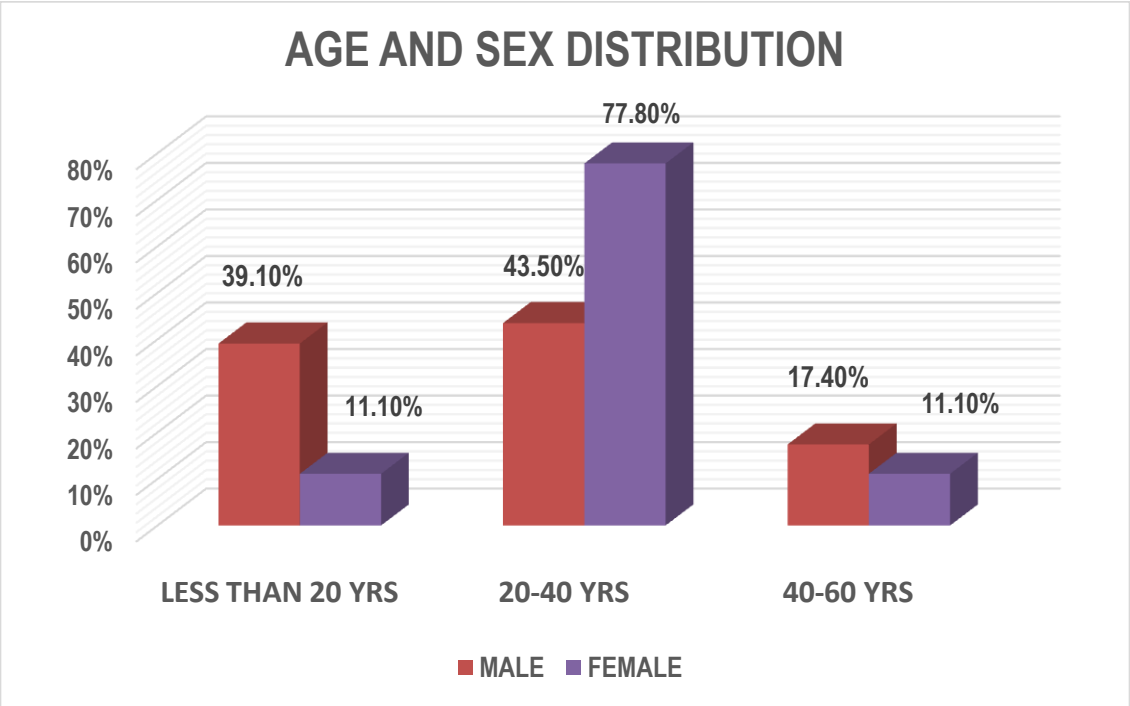
P value <0.05 was considered to be statistically significant.



AGE DISTRIBUTION	FREQUENCY	PERCENT(%)
LESS THAN 20 YRS	12	24
20 T0 40 YRS	31	62
40 TO 60 YRS	7	14
TOTAL	**50**	**100%**

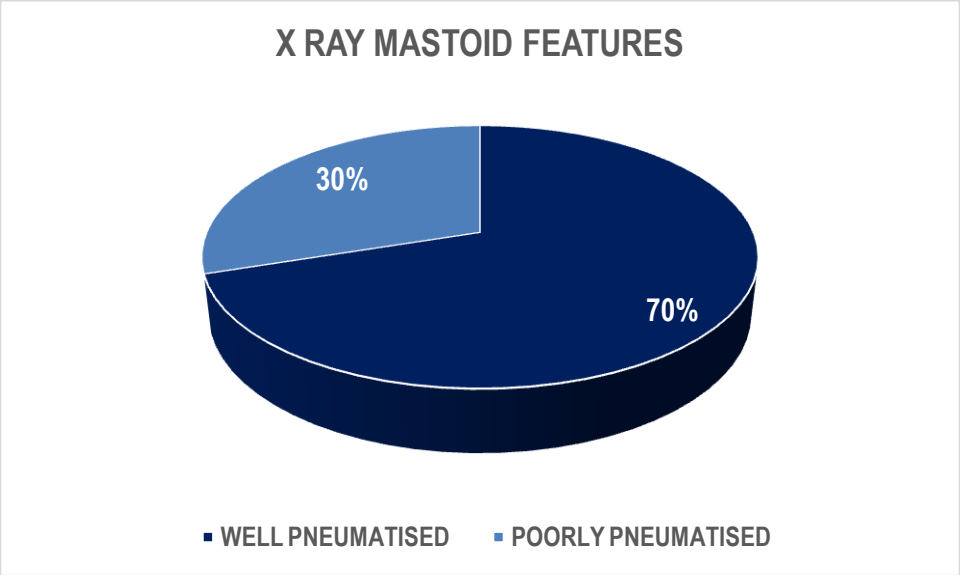
The above table and pie chart represents the age wise disease in our study population.

SEX	AGE DISTRIBUTION			
	LESS THAN 20 YRS	20-40 YEARS	>40 YEARS	TOTAL
MALE	9 (39.1%)	10(43.5%)	4 (17.4%)	**23(100%)**
FEMALE	3(11.1%)	21(77.8%)	3(11.1%)	**27(100%)**
TOTAL	**12(24%)**	**31(62%)**	**7(14%)**	**50(100%)**



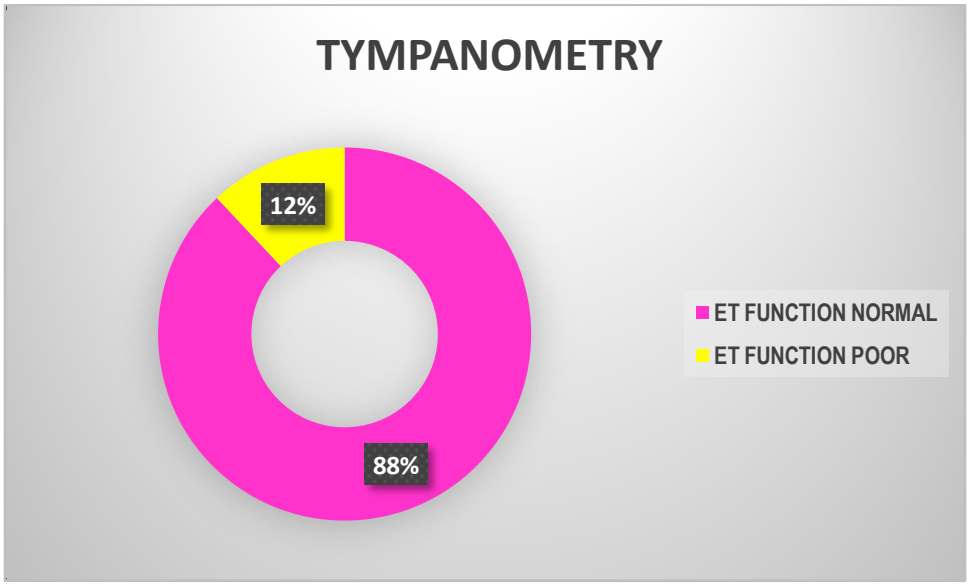
The above table and bar chart represents the age and sex distribution of the disease in our study population.

X RAY MASTOID	FREQUENCY	PERCENT(%)
WELLPNEUMATISED	35	70
POORLY PNEUMATISED	15	30
TOTAL	**50**	**100%**



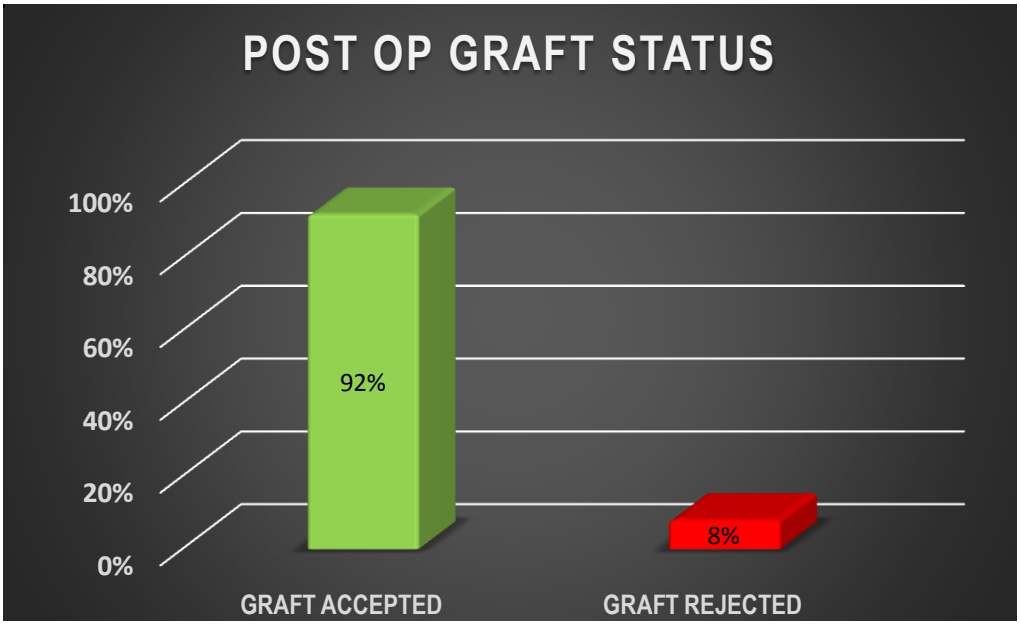
The above table and pie chart represents the frequency of pneumatisation of mastoid air cell system in our study group.

TYMPANOMETRY	FREQUENCY	PERCENT(%)
ET FUNCTION NORMAL	44	88
ET FUNCTION POOR	6	12
TOTAL	**50**	**100%**



The above table and diagram represents the frequency of Eustachian tube function using Tympanometry test in the study group.

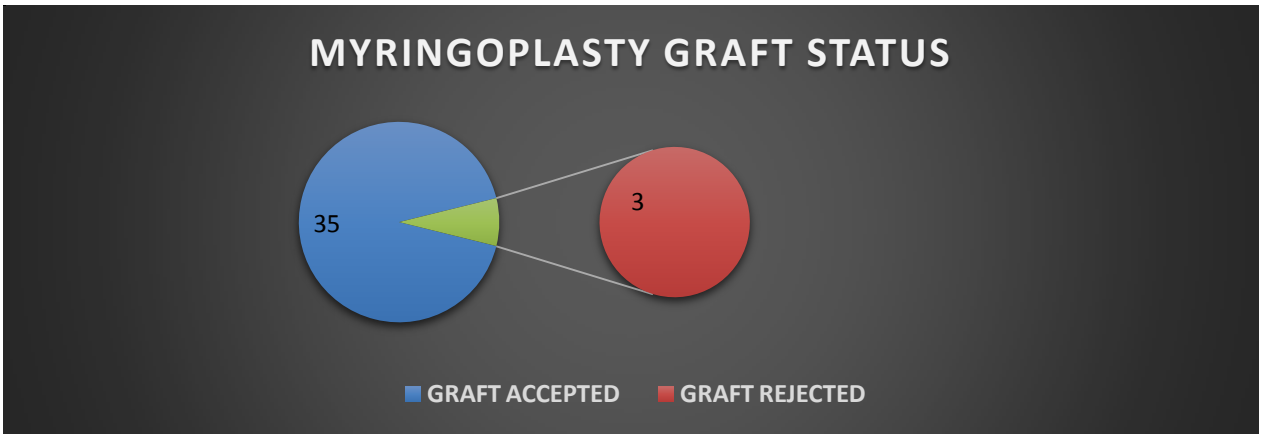
POST OPERATIVE GRAFT STATUS	FREQUENCY	PERCENT(%)
GRAFT ACCEPTED	46	92
GRAFT REJECTED	4	8
TOTAL	**50**	**100%**

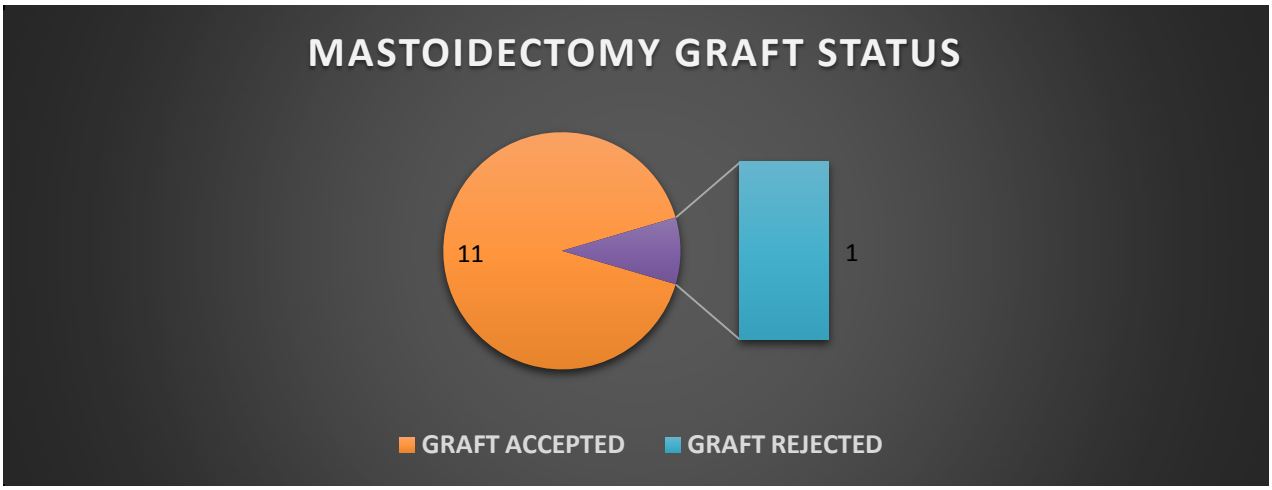


The above table and bar chart represents the frequency of post operative graft status in our study group.

SURGERY	POST OP GRAFT STATUS		
	GRAFT ACCEPTED	GRAFT REJECTED	TOTAL
MYRINGOPLASTY	35(78.3%)	3(75%)	**38(78%)**
CORTICAL MASTOIDECTOMY	11(21.7%)	1(25%)	**12(22%)**
TOTAL	**46(92%)**	**4(8%)**	**50(100%)**

CHI SQUARE-0.023 **DF-1** **P value**-0.88



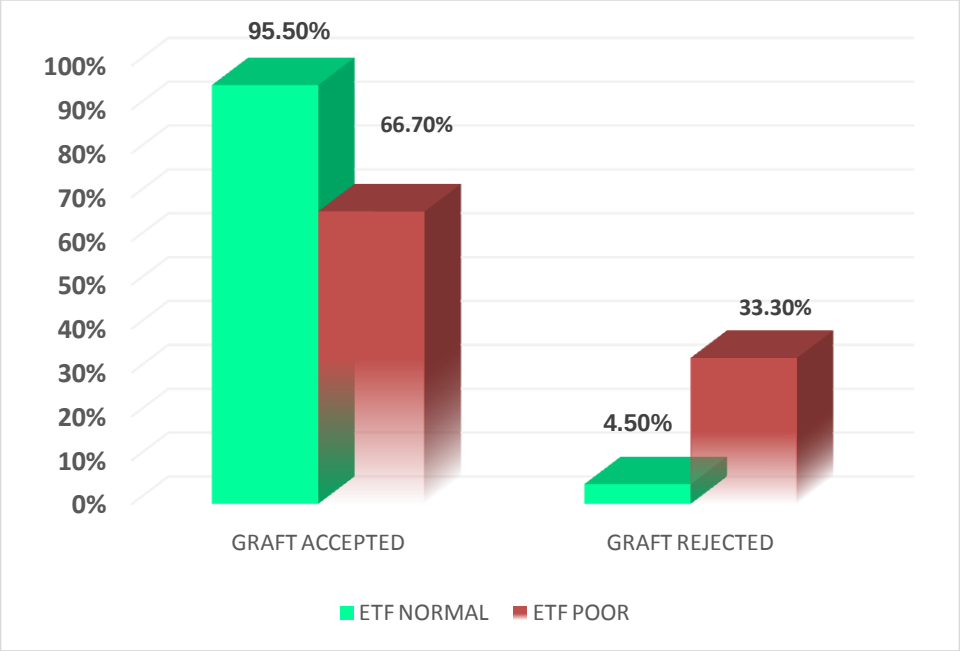


The above table and diagram represents the association between type of surgery and post operative graft status.

TYMPANOMETRY	POST OP GRAFT STATUS		
	GRAFT ACCEPTED	GRAFT REJECTED	TOTAL
ETF NORMAL	42(95.5%)	2(4.5%)	**44(100%)**
ETF POOR	4(66.7%)	2(33.3%)	**6(100%)**
TOTAL	**46(92%)**	**4(8%)**	**50(100%)**

CHI SQUARE- 5.945 DF- 1 P value-0.015(sig)

BAR CHART SHOWING ASOCIATION BETWEEN ET FUNCTION AND GRAFT UPTAKE

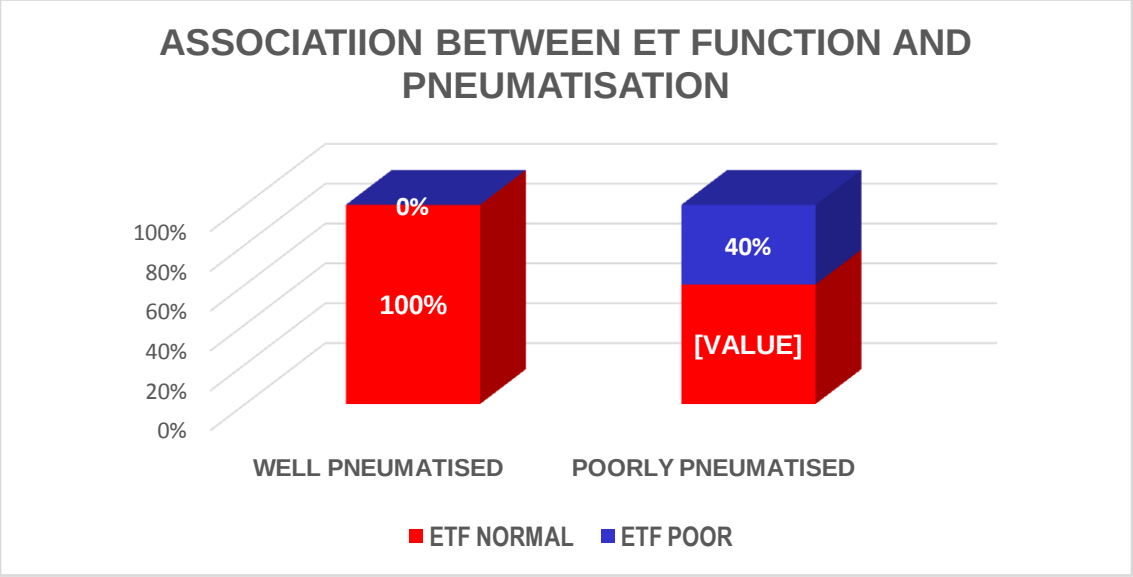


The above table and bar chart represents the association between Eustachian tube function and post operative graft status.

The P value was found to be significant 0.015.

X RAY MASTOIDS	TYMPANOMETRY		
	ETF NORMAL	ETF POOR	TOTAL
WELL PNEUMATISED	35(100%)	0(%)	**35(100%)**
POOR PNEUMATISED	9(60%)	6(40%)	**15(100%)**
TOTAL	**44(88%)**	**6(12%)**	**50(100%)**

CHI SQUARE- 15.905 DF- 1 P value-0.000(sig)

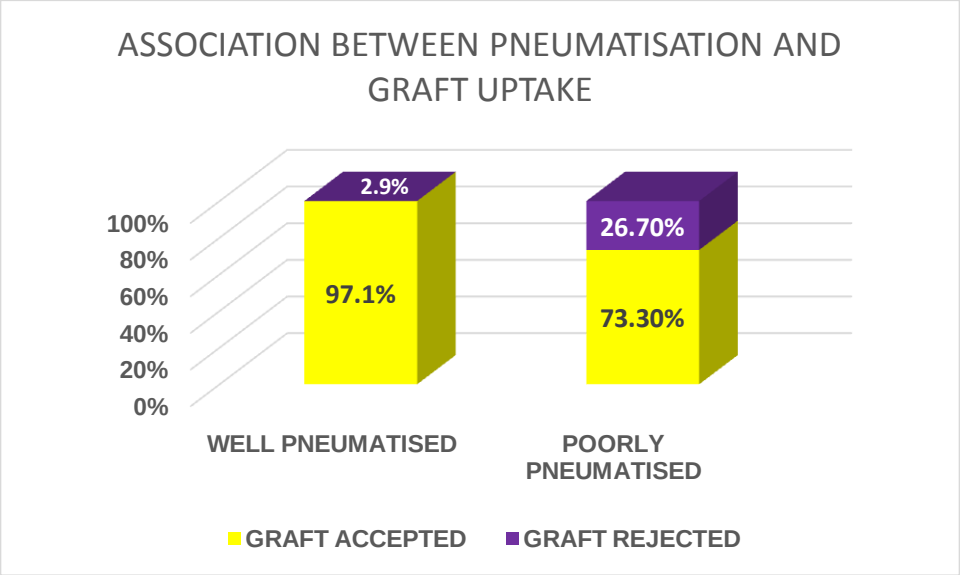


The above table and bar chart represents the association between Eustachian tube function and pneumatisation of mastoid air cells.

The P value was found to be significant 0.000

X RAY MASTOIDS	POST OP GRAFT STATUS		
	GRAFT ACCEPTED	GRAFT REJECTED	TOTAL
WELL PNEUMATISED	34(97.1%)	1(2.9%)	**35(100%)**
POOR PNEUMATISED	11(73.3%)	4(26.7%)	**15(100%)**
TOTAL	**46(92%)**	**4(8%)**	**50(100%)**

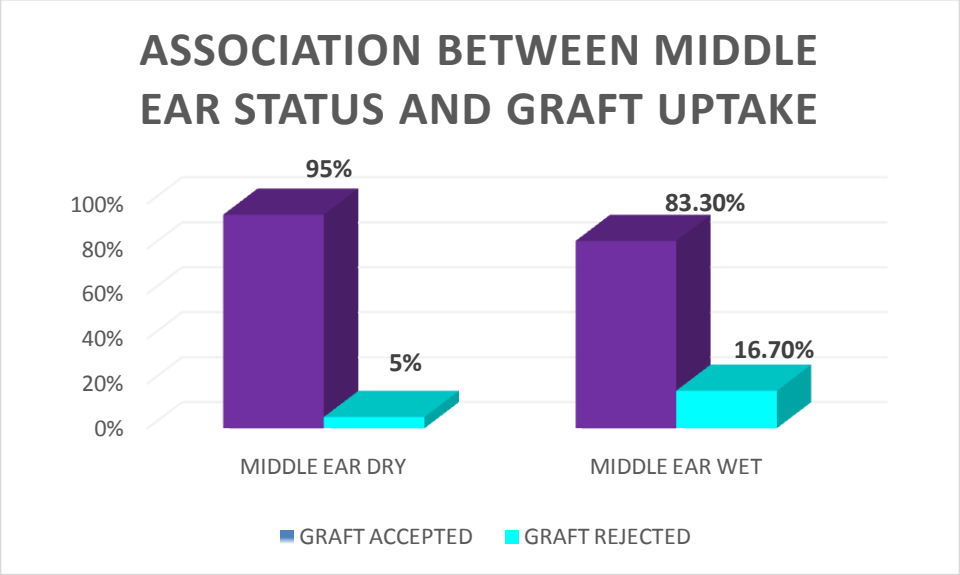
CHI SQUARE- 10.15 DF- 1 P value-0.001(sig)



The association between pneumatisation of mastoid air cells and graft uptake was found to be statistically significant 0.001.

MIDDLE EAR STATUS	POST OP GRAFT STATUS		
	GRAFT ACCEPTED	GRAFT REJECTED	TOTAL
DRY	36(94.7%)	2(5.3%)	**38(100%)**
WET	10(83.3%)	2(16.7%)	**12(100%)**
TOTAL	**46(92%)**	**4(8%)**	**50(100%)**

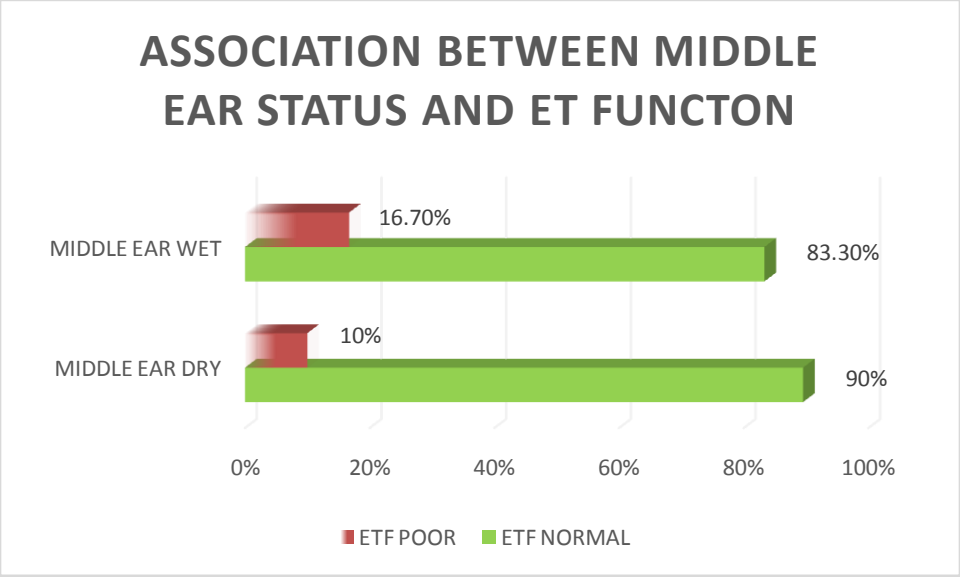
CHI SQUARE- 1.611 DF- 1 P value-0.204



The above table and bar chart represents the association between middle ear status and graft uptake.

MIDDLE EAR STATUS	ET FUNCTION		
	ETF NORMAL	ETF POOR	TOTAL
DRY	34(89.5%)	4(10.5%)	**38(100%)**
WET	10(83.3%)	2(16.7%)	**12(100%)**
TOTAL	**44(88%)**	**6(12%)**	**50(100%)**

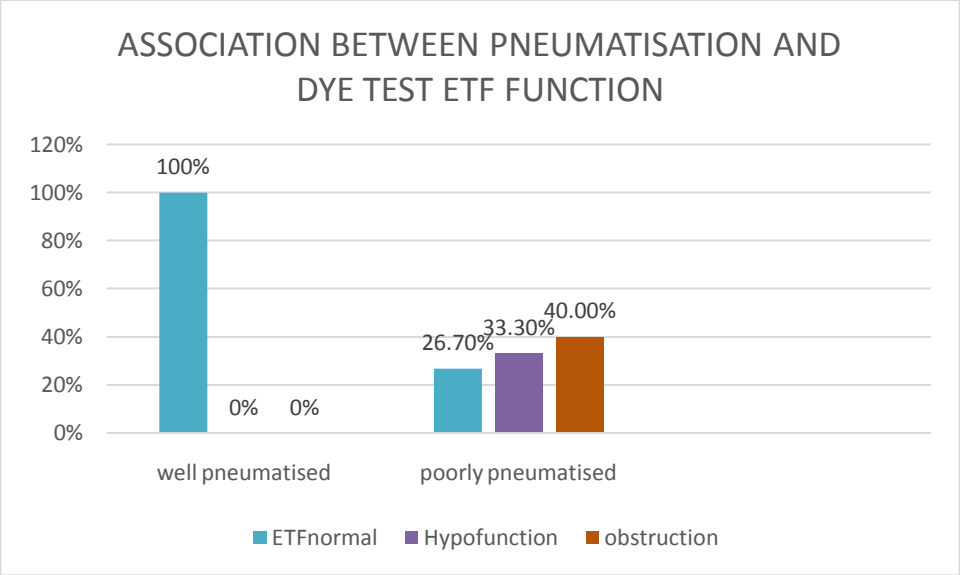
CHI SQUARE- 0.326 DF- 1 P value-0.368



The above table and bar chart represents the association between middle ear status and Eustachian tube function.

XRAY MASTOID	DYE TEST			
	ETF NORMAL	ETF HYPO FUNCTION	ETF POOR FUNCTION	TOTAL
WELL PNEUMATISED	35(100%)	0(0%)	0 (0%)	35(100%)
POORLY PNEUMATISED	4(26.7%)	5(33.3%)	6(40.0%)	15%(100%)
TOTAL	39(78%)	5(10%)	6(12%)	50(100%)

CHI SQUARE- 32.906 DF- 2 P value-0.00



The above table and bar diagram represents the association between peumatisation of mastoids and ETF using Dye Instillation test.

OBSERVATION

A total of 50 patients were selected for the purpose of this study.The study group included both adult males and females of different ages,different economic status in urban and rural population.

The Eustachian Tube functions were tested by Tympanometry and Dye Instillationtest.Thetympanometric studies revealed that,

- 6 patients had severe impairment of Eustachian tube function,
- 44 patients had normal ETF.

The Dye Instillation test was done to study the mucociliary clearance function of the Eustachian Tube.The Dye Instillation test revealed that,

- 6 patients had obstruction
- 5 patients had hypofunction
- 39 patients had normal function

The pneumatisation of mastoid air cell system was assessed by x ray mastoids.

- 15 patients had poor pneumatisation of mastoid air cells
- 35 patients had well pneumatised air cells.

The middle ear status of the patients were assessed by otoscopy and otoendoscopy.It was found that,

- 12 patients had polypoidal,edematous(moist status) middle ear mucosa.
- 38 patients had healthy(dry status) middle ear mucosa.

In our study patients with healthy (dry status) middle ear were taken up for myringoplasty and patients with polypoidal edematous(moist status) middle ear were taken up for cortical mastoidectomy.In our study out of 50 patients,

- Myringoplasty was done for 38 cases
- Cortical mastoidectomy with tympanoplasty was done for 12 cases.

Out of the 44 patients with normal ETF,

- cortical mastoidectomy was done for 10 patients and
- myringoplasty was done for 34 patients.

Out of the 6 patients with severe impairment of ETF,

- cortical mastoidectomy was done for 2 patients and
- myringoplasty was done for 4 patients.

Follow up was done after 1 month and 3 months post operatively.Patients were evaluated post operatively using otoscopy.On the basis of ear findings patients were divided into two outcome groups,

1)Successful outcome defined as healed graft

2)Graft failure or perforation was considered as failure.

In our study 46 patients had successful outcome with healed graft and 4 patients had graft failure with perforation.Out of the 4 patients with failed outcome,2 patients had normal ETF and 2 patients had impaired ETF.

In our study the pneumatisation of mastoid air cells correlated significantly with the ETF.

In our study on 50 patients with CSOM(tubotymopanic type),the preoperative ETF significantly correlated with the outcome after surgery.Patients with normal ETF showed a good graft uptake when compared with those with impaired ETF.

DISCUSSION

Several methods have been described to assess tubal function,but most of the methods used are complicated, time consuming and need elaborate instrumentation.

In 1963 **Palva and Siedentop et al** had done quantitative methods for measuring pre op tubal function in CSOM patients with perforated ear drum.

Cohen et al in 1979 assessed ETF by using impedance audiometry. Those with a normal ETF had 95% graft uptake and 69% graft uptake in impaired ETF.

Sen et al in 1998 assessed ETF using impedance audiometry. Those with normal ETF had 80% graft uptake and 66% graft uptake in impaired ETF.

Priya et al in 2012 assessed ETF using impedance audiometry. Those with normal ETF had 100% graft uptake and 76% graft uptake in impaired ETF.

Many authors used single test for assessing ETF,but in our study ETF is assessed by using impedance audiometry and Dye Instillation test. Those with normal ETF had 95.5% graft uptake and 66.7% graft uptake in impaired ETF.

In our study there was graft failure in 1 patient with normal ETF and well pneumatised mastoids which may be due to defective technique and post op infections.

In **Kurein et al** in 2009 found no relationship between mastoid pneumatisation and graft uptake.

In **Priya et al** study there was no relationship between mastoid pneumatisation and graft uptake.

In our study there is significant correlation between mastoid pneumatisation and graft uptake. Well pneumatised mastoid have 97.1% graft uptake. In poorly pneumatised mastoid there is 73.3% graft uptake.

Many authors used Dye Instillation test to study ETF. The results are:

ETF obstruction rate was 5.12% in **Takahasi et al** study, 32% in **Sethi et al study**, 18% in **Sen et al** study,23.3% in **Roy chowdhurystudy**, 22.1% in **Prasad et al** study, 50% **in Bhatta et al** study.

In our study using Dye Instillation test we found 12% with obstructed Eustachian Tube.

CONCLUSION

A properly functioning eustachian tube is an integral part of a normally functioning middle ear and the existence of good tubotympanicmucociliary drainage contributes for a favorable prognostic factor in the outcome of reconstructive surgery of the middle ear.

A functioning Eustachian Tube is an integral part of normal middle ear and is thus an essential requirement for optimum results in tympanoplastic operations.

1. In our study the correlation between ETF and the graft uptake was statistically analyzed(p value 0.015)and was found to be highly significant.Hence there is a strong association between ETF and graft uptake.
2. A pre operative test of tubal function is therefore of great interest,especially if such provides a possibility of estimating the chance of achieving a satisfactory result of tympanoplasty.
3. Impedance audiometry and Dye Instillation test are good important tools for testing ETF pre operatively and correlates well with pneumatisation of mastoid air cells and hence it predicts the operative results

4. Cortical mastoidectomy plays important role in reducing post op failure in CSOM (tubotympanic type) with impaired ETF.
5. Our method of testing ETF is easier than Bluestone 9 step test and it is non invasive than other invasive methods like ET catheterization.
6. Mastoid pneumatisation strongly correlates with ETF and graft uptake.

BIBLIOGRAPHY

1.Blue Stone CD Assessment of eustachian tube function.. In Jerger J (Ed) : Handbook of clinical Impedance Audiometry, New York, American Electromedics corporation, 1975 pp 17-148

2.Blue Stone CD Assessement of eustachian tube function. In Jerger J and Norther J (Eds) Clinical Impedance Audiometry, New York American Electromedics corporation, 1980, pp. 83-108

3. Cantekin EI, Doyle WJ, Reichert TJ, Phillips DC and Bluestone CD Dilation of the Eustachian tube by electrical stimulationof the trigeminal nerve, Ann. OtoalRhinolLaryngol, 88:40-51. 1979.

4.Cohn AM eustachain tube function and tympanoplasty. Ann. Otol 1979:8:339-47

5. Comprere WE (Jr) The radiologic evaluation of eustachian tube function, Arch. Otolaryngol, 81:385,1960

6. Honjo I, Okajaki N, Kamazawa T Experimental study of eustachian

tube function with regard to its related muscles. ActaOtolaryngol (Stockh) 87:84-39,1979

7. HonjoIm Okazaki N, and Kumajawa T Experimental study of the pumping function of the Eustachian Tube. ActaOtolaryngol (Stockh) 91:85-89,1981

8. Murti K. Stem, R. Cantekin El and Bluestone CD Sonometric evaluation of eustachian tube function using broadband, stimuli, Anna OtolRhinolLaryngol, 89 (C suppl 68) 178-184 1980

9. Niwa H, Takahashi M. Yaniata N. Naganawa s Evolution of clearance function of the eustachian tube by sequential C.T. Actaotolaryngol (Stockh) 1990, a supp, 471 (43) 50.

10. Paparella M. Shumirick D. Gluekman J. Meyerhoffw otolaryngology, vol 1(1991) physiology of middle ear and E tube,163-197

11. Sato H, Nakamura H, Hayashi M, Honjo I Eustachian tube fucntion in tympanoplasty. ActaOtolaryngol (Stockh) 1990, supply 471:9-1.

12. Palva T (1987), Surgical treatment of Chronic middle ear disease, Myringoplasty and tympanoplasty. ActaOtolaryngological, 104(3-4);

13. Perlamna HB (1967) Normal tubal funciton. Arch Otolaryngol 86:58.

14. Jahn A.F. (1996) Eustachian tube fucntion and the middle ear-editorial in India Jouranl of Otology vol.. No.4 pp 151-153.

15. Morimitsu, T, et al., (1981)' A new test of Eustachian tube function with otoadmittance meter tubotympanometry. ActaOtolaryngol (Stockh); 1981 Mar-Apr; 91 (3-4):07-14.

16.Yagi N., Haj T,Honjo I. (1987) Eustachian tube patency detected by a photoelectric method, Laryngoscope, 97(6), 73-36

17. Riedel CL, Wiley TL, Block MG (1987): Tympanometric measures eustachian tube funciton. Journal Speech & Hearing Research

18.Gimenez R., Marco Algarra I., Carbonell R., Prognositc factors in tympanoplasty: (1993) a statistical evaluation. Revue de Laryngologies OtologicRhinologic; 114 (5) 335

19.El-Guindy A, (1993): Manometric and endoscopic study of tuba function indrum perforation American Journal of Otology; 1406) 580

20.Bluestone CD et al., (197) Roentgenographic evaluation of eustachian tube function infacts with cleft and noramlpalest.Cleft Palate Journal

21. Sen. S., Guhas, Biswas. A., g Gosh L M., (1998) A comparative study of methods of evaluation of eustachina tube functions in chronic otitis media. India Journal of Otology; Vol.4, No.3, pp.147-149.

22.Palva T. Surgical treatment of chronic middle ear disease, myringoplasty and tympanoplasty. ActaOtolaryngol 1987;104:179-84

23.KPriya,Evaluation of ETF in CSOM(Tubotympanic) with reference to its treatment outcome, Indian Journal of Otology | October 2012 | Vol 18 | Issue 4|

ANNEXURES

PROFORMA

Name: Age: Sex:

Address IP/OP.NO:

Occupation Income:

Chief complaints

EAR

A) Discharge

1. Duration
2. Onset
3. Nature
4. Colour
5. Amount
6. Smell
7. Blood stained
8. Aggravating/relieving factors
9. Associated symptoms

B) Hard of Hearing

Onset

Unilateral/ Bilateral

Gradual/ Fluctuating

C) Ear ache

D) Vertigo / Tinnitus

NOSE

A) Obstruction

B) Discharge

C) Anosmia

D) Sneezing

E) Headache

F) Snoring

History of Smoking

EXAMINATION

EAR	**Right**	**Left**
Pinna		
Preauricular region		

Postauricular region

External auditory canal

Tympanic membrane

Perforation

Site

Size

Small

Medium

Large

Middle ear mucosa

Dry

Boggy

Moist

Nose

Anterior rhinoscopy

Diagnostic nasal endoscopy

Pure tone audiogram

X ray mastoids

ETF tests using Impedance audiometry

Dye test

Normal

Hypofunction

Obstruction

PATIENT CONSENT FORM

Title of the Project : EVALUATION OF EUSTACHIAN TUBE FUNCTION IN CHRONIC SUPPURATIVE OTITIS MEDIA (TUBOTYMPANIC TYPE) WITH REFERENCE TO ITS SURGICAL OUTCOME

Institution : Upgraded Institute of Otorhinolaryngology,
Madras Medical College,
Chennai – 600003.

Name : Date :

Age : IP No. :

Sex : Project Patient No. :

The details of the study have been provided to me in writing and explained to me in my own language.

I confirm that I have understood the above study and had the opportunity to ask questions.

I understood that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected.

I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

I have been given an information sheet giving details of the study.
+
I fully consent to participate in the above study.

_____	_____	_____
Name of the subject	Signature	Date
_____	_____	_____
Name of the Investigator	Signature	Date

INFORMATION SHEET

- We are conducting a prospective cohort study on **"EVALUATION OF EUSTACHIAN TUBE FUNCTION IN CHRONIC SUPPURATIVE OTITIS MEDIA (TUBOTYMPANIC TYPE) WITH REFERENCE TO ITS SURGICAL OUTCOME"** at the Upgraded Institute of Otorhinolaryngology, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai – 600003.

- The Eustachian tube patency and function is assessed by impedance audiometry and dye test in the pre-op period
- Surgical treatment (tympanoplasty) will be given and the outcome of the procedure will be analyzed with reference to the ETF.
- At the time of announcing the results and suggestions, name and identity of the patients will be confidential.
- Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.
- The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator **Signature of Participant**

Date :

S. NO.	NAME	AGE	SEX	DIAGNOSIS	DURATION	PTA	X-RAY MASTOIDS	MIDDLE EAR STATUS	TYMPANOMETRY	DYE TEST	SURGERY DONE	POST OP FOLLOWUP
1	KATHUN	30	F	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
2	SHANTHI.E	45	F	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
3	KALAISELVAN	14	M	B/L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
4	BADAL	20	M	B/L CSOM WITH CP	< 2 yrs	Moderate CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
5	MADHAN	30	M	L CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Polypoidal, wet ear	ETF normal	Hypo function	L CORTICAL MASTOIDECTOMY	Graft uptake - good
6	KARTHIK	25	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
7	JOTHI	40	F	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
8	LAKSHMI	34	F	L CSOM WITH CP	< 2 yrs	Moderate CHL	Poorly Pneumatised	Polypoidal, wet ear	ETF normal	Hypo function	L CORTICAL MASTOIDECTOMY	Graft uptake - failed
9	JOTHILAKSHMI	27	F	R CSOM WITH CP	> 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
10	AMMU	35	F	R CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Polypoidal, wet ear	ETF normal	Normal	R CORTICAL MASTOIDECTOMY	Graft uptake - good
11	SATHYA	23	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
12	SHANTHI	23	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
13	SIVAPRASAD RAO	35	F	L CSOM WITH CP	< 2 yrs	Moderate CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - failed
14	KAVITHA	18	F	R CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Wet	ETF normal	Hypo function	R CORTICAL MASTOIDECTOMY	Graft uptake - good
15	JAYALAKSMI	38	F	R CSOM WITH CP	> 2 yrs	Mild CHL	Well Pneumatised	Polypoidal, wet ear	ETF normal	Normal	R CORTICAL MASTOIDECTOMY	Graft uptake - good
16	CHERALATHAN	38	M	B/L CSOM WITH CP	< 2 yrs	Moderate CHL	Poorly Pneumatised	Polypoidal, wet ear	ETF impaired	Obstruction	L CORTICAL MASTOIDECTOMY	Graft uptake - good
17	MALAR	25	F	B/L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
18	KALPANA	25	F	B/L CSOM WITH CP	> 2 yrs	Mild CHL	Poorly Pneumatised	Wet	ETF normal	Hypo function	L CORTICAL MASTOIDECTOMY	Graft uptake - good
19	PALANIAMMAL	40	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
20	KARTHI	19	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good

S. NO.	NAME	AGE	SEX	DIAGNOSIS	DURATION	PTA	X-RAY MASTOIDS	MIDDLE EAR STATUS	TYMPANOMETRY	DYE TEST	SURGERY DONE	POST OP FOLLOWUP
21	NAZRULLA	24	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
22	LATHA	42	F	R CSOM WITH CP	< 2 yrs	Moderate CHL	Poorly Pneumatised	Healthy, dry ear	ETF impaired	Obstruction	R MYRINGOPLASTY	Graft uptake - good
23	PADMAVATHI	30	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
24	SARASWATHI	20	F	L CSOM WITH CP	< 2 yrs	Moderate CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
25	RAJESHWARI	29	F	B/L CSOM WITH CP	> 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
26	SURIYA	40	F	B/L CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
27	DEVI	31	F	B/L CSOM WITH CP	> 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
28	SARASWATHI	35	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
29	RAVICHANDRAN	54	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
30	LAKSMI	23	F	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
31	GEETHA	35	F	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
32	MUHAMMED RIZWAN	15	M	R CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Healthy, dry ear	ETF impaired	Obstruction	R MYRINGOPLASTY	Graft uptake - failed
33	REVATHY	55	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
34	SURYA	15	M	L CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Wet	ETF impaired	Obstruction	L CORTICAL MASTOIDECTOMY	Graft uptake - good
35	SANKAR	63	M	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
36	RAMANATHAN	59	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
37	SHANMUGAM	40	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
38	SURESH	26	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
39	VIGNESH	17	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
40	CHIDAMBARAM	13	M	L CSOM WITH CP	< 2 yrs	Mild CHL	Poorly Pneumatised	Healthy, dry ear	ETF impaired	Obstruction	L MYRINGOPLASTY	Graft uptake - good
41	MUTHUSWAMY	39	M	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
42	RAJA	24	M`	L CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Polypoidal, wet ear	ETF normal	Hypo function	L CORTICAL MASTOIDECTOMY	Graft uptake - good
43	KALAISELVAM	13	M	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
44	ALAMELU	31	F	B/L CSOM WITH CP	> 2 yrs	Moderate CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good

S.NO.	NAME	AGE	SEX	DIAGNOSIS	DURATION	PTA	X-RAY MASTOIDS	MIDDLE EAR STATUS	TYMPANOMETRY	DYE TEST	SURGERY DONE	POST OP FOLLOWUP
45	RAMESH	24	M	B/L CSOM WITH CP	> 2 yrs	Moderate CHL	Poorly Pneumatised	Wet	ETF normal	Normal	L CORTICAL MASTOIDECTOMY	Graft uptake - good
46	THILAGAVATHY	35	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Poorly Pneumatised	Healthy, dry ear	ETF impaired	Obstruction	R MYRINGOPLASTY	Graft uptake - failed
47	#NAME?	13	F	R CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	R MYRINGOPLASTY	Graft uptake - good
48	RAJAVEL	45	M	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Healthy, dry ear	ETF normal	Normal	L MYRINGOPLASTY	Graft uptake - good
49	ARUMUGAM	60	M	L CSOM WITH CP	< 2 yrs	Mild CHL	Well Pneumatised	Wet ear	ETF normal	Normal	L CORTICAL MASTOIDECTOMY	Graft uptake - good
50	SASIBALA	37	F	R CSOM WITH CP	> 2 yrs	Moderate CHL	Well Pneumatised	Wet ear	ETF normal	Normal	R CORTICAL MASTOIDECTOMY	Graft uptake - good

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No. 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.M.Yoganandh
Postgraduate M.S.(ENT)
Madras Medical College
Chennai 600 003

Dear Dr.M.Yoganandh,

The Institutional Ethics Committee has considered your request and approved your study titled **"Evaluation of Eustachian Tube function in chronic suppurative otitis media (Tubotympanic Type) with reference to its surgical outcome" No.12032015.**

The following members of Ethics Committee were present in the meeting held on 03.03.2015 conducted at Madras Medical College, Chennai-3.

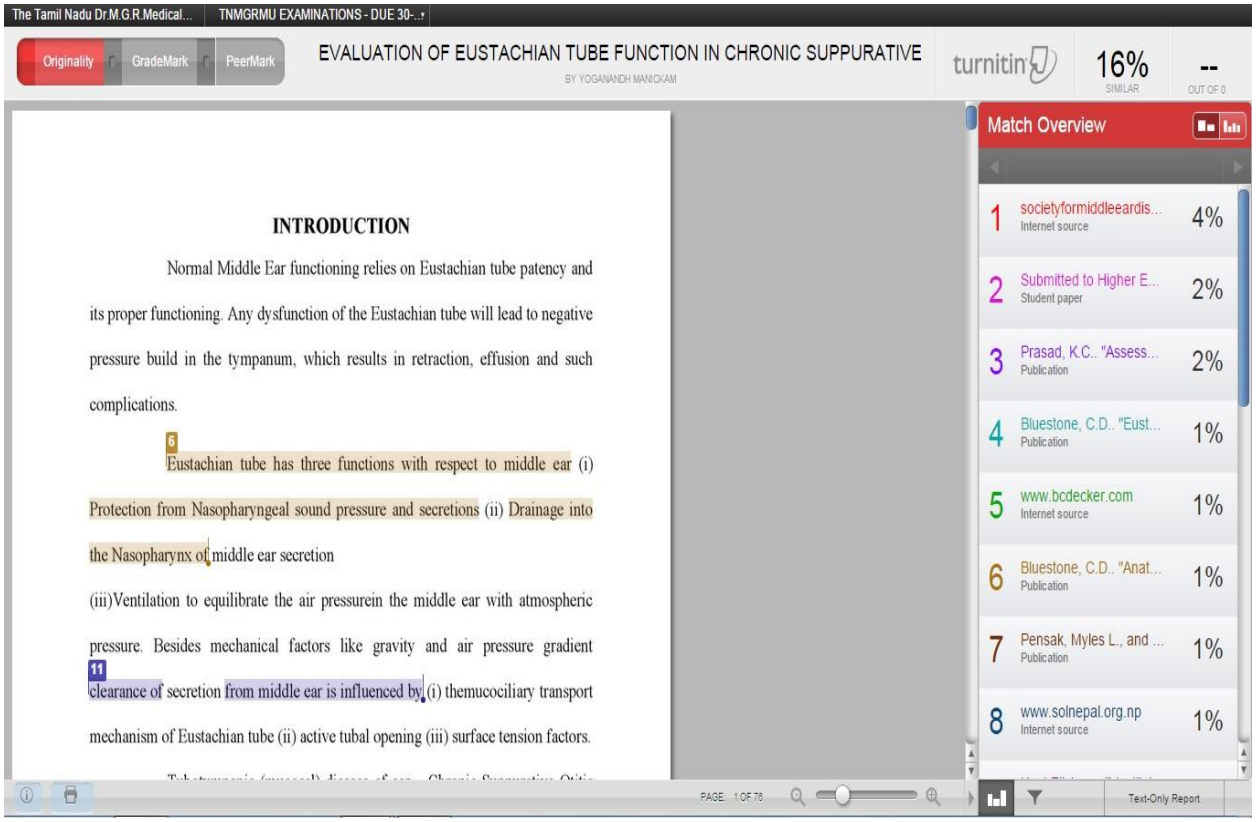
1. Prof.C.Rajendran, M.D.,	: Chairperson
2. Prof.R.Vimala, M.D., Dean, MMC, Ch-3	: Deputy Chairperson
3. Prof B.Kalaiselvi, M.D., Vice-Principal, MMC, Ch-3	: Member Secretary
4. Prof.R.Nandini, M.D., Inst.of Pharmacology, MMC	: Member
5. Prof P.Ragumani, M.S., Professor, Inst.of Surgery, MMC	: Member
6. Prof.Md.Ali, M.D., D.M., Prof. & HOD of Medl.G.E., MMC	: Member
7. Prof.K.Ramadevi, Director, Inst.of Biochemistry, MMC	: Member
8. Prof.Saraswathy, M.D., Director, Pathology, MMC, Ch-3	: Member
9. Prof.S.G.Sivachidambaram, M.D.,Director i/c Institute of Internal Medicine, MMC, Ch-3	: Member
10.Thiru S.Rameshkumar, B.Com., MBA	: Lay Person
11.Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
12.Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI

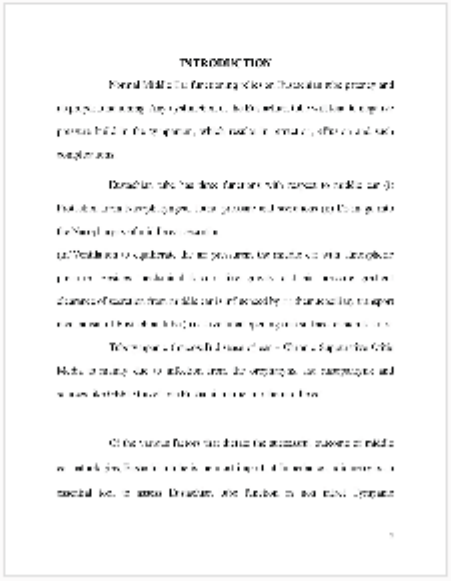

The Tamil Nadu Dr.M.G.R.Medical...
TNMGRMU EXAMINATIONS - DUE 30-..
Originality
GradeMark
PeerMark
EVALUATION OF EUSTACHIAN TUBE FUNCTION IN CHRONIC SUPPURATIVE
BY YOGANANDH MANICKAM
turnitin
16%
SIMILAR
--
OUT OF 0
INTRODUCTION
Normal Middle Ear functioning relies on Eustachian tube patency and its proper functioning. Any dysfunction of the Eustachian tube will lead to negative pressure build in the tympanum, which results in retraction, effusion and such complications.
Eustachian tube has three functions with respect to middle ear (i) Protection from Nasopharyngeal sound pressure and secretions (ii) Drainage into the Nasopharynx of middle ear secretion
(iii)Ventilation to equilibrate the air pressurein the middle ear with atmospheric pressure. Besides mechanical factors like gravity and air pressure gradient clearance of secretion from middle ear is influenced by (i) themucociliary transport mechanism of Eustachian tube (ii) active tubal opening (iii) surface tension factors.
PAGE: 1 OF 76
Match Overview
1 societyformiddleeardis... Internet source 4%
2 Submitted to Higher E... Student paper 2%
3 Prasad, K.C.. "Assess... Publication 2%
4 Bluestone, C.D.. "Eust... Publication 1%
5 www.bcdecker.com Internet source 1%
6 Bluestone, C.D.. "Anat... Publication 1%
7 Pensak, Myles L., and ... Publication 1%
8 www.solnepal.org.np Internet source 1%
Text-Only Report

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Yoganandh Manickam
Assignment title:	TNMGRMU EXAMINATIONS
Submission title:	EVALUATION OF EUSTACHIAN TU...
File name:	plagiarism_copy_final30.9.15.docx
File size:	8.1M
Page count:	76
Word count:	6,539
Character count:	37,753
Submission date:	30-Sep-2015 07:34PM
Submission ID:	573344928



INTRODUCTION